PARK COUNTY, MONTANA
CITY OF LIVINGSTON, MONTANA
TOWN OF CLYDE PARK, MONTANA

HAZARD MITIGATION PLAN

August 2005

Upper Yellowstone River Flooding in 1997
Photo Courtesy of USGS and Upper Yellowstone River Task Force

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Park County Hazard Mitigation Plan
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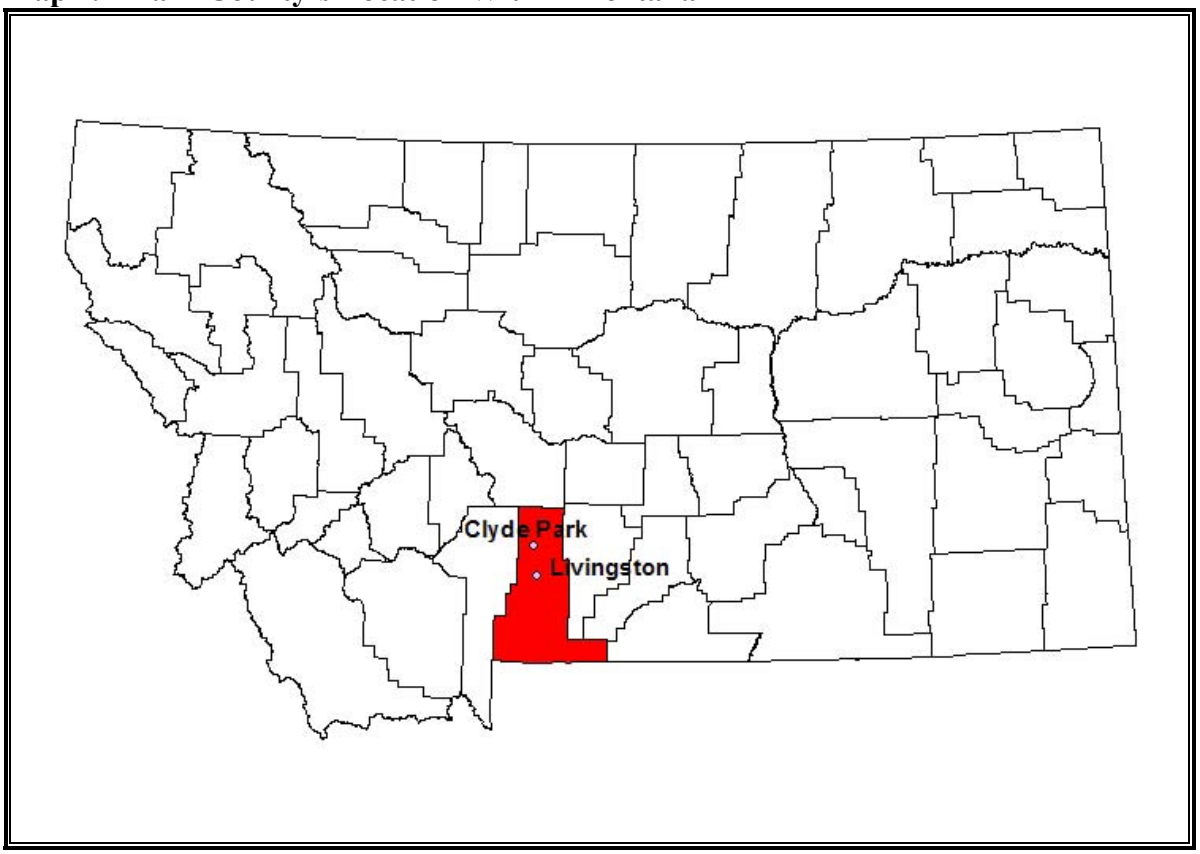
1. Adoption Documentation

2. Introduction

Park County, the City of Livingston, and the Town of Clyde Park in Montana are taking the steps necessary to become disaster resistant communities, and through their initiative, have written this plan to meet the requirements of the Interim Final Rule published in the Federal Register on February 26, 2002 at 44 CFR Part 201 as part of the Disaster Mitigation Act of 2000. The initial planning document was funded by Montana Disaster and Emergency Services through a Department of Homeland Security, Federal Emergency Management Agency Pre-Disaster Mitigation grant. The plan's intent is to assist the communities in making financial decisions for mitigation projects and clarify actions that can be taken through additional funding. Hopefully through the planning process, the communities have become more aware of their hazards and will continue to take a proactive approach to disaster prevention.

Park County is located in south central Montana as shown in Map 2.1. According to the 2000 US Census data, Park County has a population of 15,694 and an area of 2,802 square miles. Within Park County, 6,851 of the residents live within the city limits of Livingston covering approximately 2.6 square miles. The Town of Clyde Park, north of Livingston, has a population of approximately 310 with an area of 0.3 square miles. A population of 8,533 lives in the unincorporated areas of Park County, including the communities of Cooke City, Corwin Springs, Emigrant, Gardiner, Grannis, Jardine, Pine Creek, Pray, Silver Gate, Springdale, and Wilsall.[1]

Map 2.1 Park County's Location Within Montana



[1] US Census Bureau, October 2004. http://www.census.gov/

Park County is home to the beautiful and agricultural Paradise and Shields Valleys. The county offers a wide variety of sights and outdoor activities including hunting, fishing, cross country skiing, swimming in hot springs, horse back riding, and camping trips. Wildlife abounds throughout the county. Livingston, the county seat, is also known as the Gateway to Yellowstone National Park. Major scenic roadways include U.S. Highway 89 from north of Wilsall south to Gardiner. Interstate 90 runs through Park County from Springdale to 10 miles west of Livingston and runs parallel to the tracks that once carried hundreds of passengers on the Northern Pacific Railroad. Of course, the scenic and well traveled roadways also include the north entrance of Yellowstone National Park and US Highway 212 from the northeast entrance of Yellowstone National Park to the west end of the Beartooth Scenic Byway including Cooke City and Silver Gate.

The Yellowstone River flows through Park County from Gardiner through Livingston to Springdale. The Shields River runs from the Crazy Mountains in northeast Park County south to the Yellowstone River east of Livingston. Park County is bordered by Meagher County to the north, Gallatin County to the west, Sweet Grass County to the east, and Wyoming to the south. The elevation ranges from approximately 4,000 to 12,000 feet.[2]

Much of the Yellowstone River basin was inhabited by the Crow Indians until the expedition of Lewis and Clark traveled through in the early 1800's. In the decades that followed, the region was explored by trappers, gold diggers, and early settlers. Yellowstone National Park became the nation's first national park in 1872. The Northern Pacific Railroad, completed in the 1880's, increased the population in Park County from 200 in 1880 to 6,900 in 1890. Steady growth has brought the population to what it is today.[3]

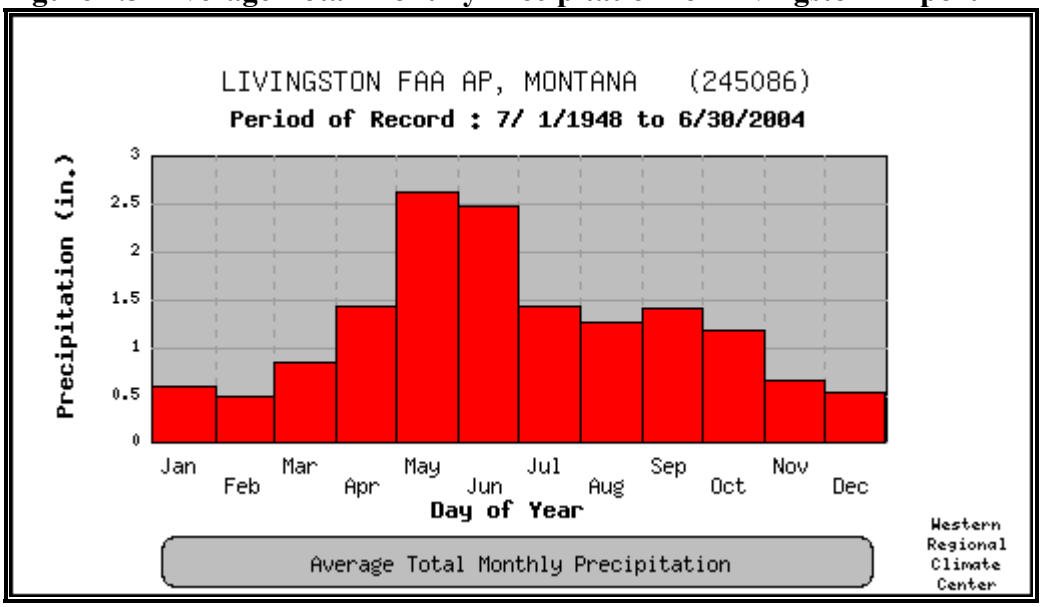
The climate of Park County varies greatly. Table 2.2 shows the variations between three stations in the county. Figure 2.3 shows when the precipitation typically falls during the year.

Table 2.2 Weather Statistics from Across Park County[4]

	Livingston Airport 1948-2005	8 miles ENE of Wilsall 1957-2005	Gardiner 1956-2005
Minimum Temperature	-41°F	-42°F	-31°F
Maximum Temperature	105°F	99°F	103°F
Average # of Days Below Freezing	161 days	207 days	174 days
Average Annual Precipitation (liquid equivalent)	15 inches	20 inches	10 inches
Lowest Annual Precipitation	9 inches	14 inches	6 inches
Highest Annual Precipitation	23 inches	31 inches	15 inches
Average Annual Snowfall	60 inches	100 inches	25 inches
Highest Annual Snowfall	114 inches	210 inches	75 inches

[2] Park County, Montana, October 2004. http://www.parkcounty.org/
[3] Romsa, Jim and Carol, History of Park County, June 9, 2004. http://www.parkcounty.org/History/history.html
[4] Western Regional Climate Center, October 2004. http://www.wrcc.dri.edu/

Figure 2.3 Average Total Monthly Precipitation for Livingston Airport[4]



Park County is well known for its wind. A study of the past ten years shows that Park County was the third windiest county in Montana for synoptic scale winds. Over the ten year period, Park County had 22 reports of wind gusts of 75 mph or greater from non-thunderstorm winds.[5] Therefore, on average, at least two occurrences of greater than hurricane force winds can be expected each year. Park County is also prone to many other types of weather related hazards including flooding, winter storms, extended cold, wind, severe thunderstorms, tornadoes, and drought.

The mountainous terrain of Park County, ranging in elevation from approximately 4,000 to 12,000 feet, and its proximity to an active volcanic caldera, also presents geologic and terrain related hazards. The mountainous forests can spark large wildfires, and occasionally avalanches and landslides, while the active seismic area to the south makes Park County prone to earthquakes and volcanic eruptions. These hazards are all formidable problems in Park County.

Despite its natural beauty, manmade hazards also exist in Park County. The major US interstate, active railways, airports, and fixed facilities put Park County at risk for transportation accidents and hazardous material releases. Dam failure, utility outages, terrorism, civil unrest, violence, communicable disease, bioterrorism, and urban fire all have the potential to affect Park County.

Despite these hazards, Park County, Livingston, and Clyde Park hope this plan identifies those hazards that greatest threaten the communities and outlines solutions to mitigate future damages. Additional hazards may exist that are not apparent to the local government or residents, and certainly, hazards can occur in unexpected ways. Although any and all hazards cannot be fully mitigated, hopefully, this plan will help the communities understand the hazards better and become more disaster resistant.

[5] Montana Disaster and Emergency Services, State of Montana Multi-Hazard Mitigation Plan and Statewide Hazard Assessment, October 2004.

3. Planning Process

The planning process used in developing this Hazard Mitigation Plan attempted to maximize community input and utilize a wide variety of informational resources. The planning process began in March 2004 with an advertised public meeting that was held in conjunction with the regularly scheduled Local Emergency Planning Committee (LEPC). The LEPC consists of representatives from emergency management, fire services, medical and health services, law enforcement, media, voluntary organizations, and government administration. This already active committee was determined to be an excellent core group because of its broad representation. The jurisdictions of Park County and Livingston are represented on the LEPC, however, a representative from Clyde Park is not. Therefore, an additional meeting was held in Clyde Park in May 2004. Although not an incorporated community, a meeting was scheduled in Gardiner for May 2004, but little interest was generated. Documentation of the newspaper and newsletter notices can be found in Appendix A. Attendance records can be found in Appendix B.

The first public meeting in March 2004 was advertised through public notice in the Livingston Enterprise newspaper and press releases were sent to local radio stations, television stations, print media offices, Chambers of Commerce, and hospitals. Several members attending the first meeting had heard the announcements over the radio. This first public meeting introduced the attendees to the planning process. The group then identified the primary hazards in the county and participants were surveyed on their individual hazard prioritizations.

The second round of public meetings in May 2004 was again advertised through another public notice in the Livingston Enterprise newspaper. Meetings were scheduled in Clyde Park, Livingston, and Gardiner. The Clyde Park meeting was well attended and was held during the regularly scheduled Town Meeting. Attendees identified and prioritized hazards specific to Clyde Park and identified each of the critical facilities. Attendees of the brown bag lunch meeting in Livingston were valuable in identifying critical facilities and hazard experts. Although Gardiner is not an incorporated community, the meeting was designed to gather input from the public residing in the southern part of the county. The Gardiner meeting was advertised in the Chamber of Commerce newsletter, a well known community publication, but unfortunately, generated no interest.

Additional meetings were held in January 2005, April 2005 (publicly advertised), and July 2005 with the LEPC for the purposes of identifying critical facilities, reviewing draft sections, and developing mitigation strategies. Once draft sections were completed, they were distributed over e-mail for review. The full draft of this plan was posted on a website to solicit public review and comment. Final public meetings soliciting comments on the full draft plan were held in Livingston in August 2005 and in Clyde Park in September 2005. These meetings were advertised in the Livingston Enterprise newspaper.

Future updates of this plan will continue to use public input as described in the Plan Maintenance Procedures section.

4. Risk Assessment

This all hazard risk assessment serves as a single source for hazard information in Park County. Other plans may be referenced and remain vital hazard documents, but each hazard has its own profile in this plan. As more data becomes available and disasters occur, the individual hazard profiles can be expanded or new hazards can be added. This summary of hazards identifies and describes the hazards that threaten Park County, including Livingston and Clyde Park, and determines the values at risk from those hazards. The risk assessment is the cornerstone of the mitigation strategy and provides the basis for many of the proposed actions.

Hazard Identification

Park County is exposed to many hazards. The hazards were identified and profiled through several different means. Hazards were initially identified by participants in the first public meeting. Participants included government, the private sector, and the public. Then, a history of past events was gathered and possible future events were recognized through internet research, available GIS data, archives research, public meetings, subject matter experts, and an examination of existing plans.

The hazards (in alphabetical order) have been identified as follows in Table 4.1 The level of detail for each hazard is based on the relative risk of each hazard to the communities and is limited by the amount of data available.

Table 4.1 Hazards Identified in Park County, Livingston, and Clyde Park, Montana

Hazard	Jurisdiction	How Identified	Why Identified
Avalanche and Landslide	• Park County	• State DES Website • Historical records from the Avalanche.org database • Colorado Avalanche Information Center • Montana Hazard/Vulnerability Analysis, 1989 • USGS National Landslide Study • Montana Department of Transportation District 2 Priorities • Public meeting input	• Mountainous terrain exists that may be prone to avalanches and landslides • The county has frequent avalanches involving the population • Priority landslide areas exist along roadways in the county • The county has areas of landslide incidences and susceptibility based on a USGS study
Aviation Accident	• Park County • Livingston • Clyde Park	• Research of NTSB database • Public meeting input	• The county has four airports • Long history of incidents, some with casualties
Communicable Disease and Bioterrorism	• Park County • Livingston • Clyde Park	• Centers for Disease Control and Prevention website • Public meeting input	• Large number of livestock areas • History of an influenza outbreak during the 1910's • The area is highly traveled by tourists • Rapid disease spread potential through urban areas
Dam Failure	• Park County • Clyde Park	• National Inventory of Dams website • Dam Emergency Action Plans	• One high hazard dam and several significant hazard dams exist in the county

Table 4.1 (continued) Hazards Identified in Park County, Livingston, and Clyde Park, Montana

Hazard	Jurisdiction	How Identified	Why Identified
Drought	• Park County • Livingston • Clyde Park	• Montana Drought Advisory Committee website • National Drought Mitigation Center website • Data from the Western Regional Climate Center • State DES website • NOAA Paleoclimatology Program website • Public meeting input	• Frequent historical drought events • USDA Disaster Declarations • Relationship to wildfire danger • Impact to agricultural community • Impact on natural resources and tourism
Earthquake	• Park County • Livingston • Clyde Park	• Montana Bureau of Mines and Geology publication and website • USGS National Seismic Hazard Mapping Project website • University of Utah Seismograph Stations website • USGS National Earthquake Information Center website	• History of nearby earthquakes greater than 6.0 magnitude • Proximity to the active geological region of Yellowstone National Park
Flooding	• Park County • Livingston • Clyde Park	• FEMA Flood Insurance Study and Rate Maps • Park County DES documents • Park County Flood Mitigation Plan	• Extensive history of significant flooding • Two Presidential declared disasters in the past ten years • Large areas of identified floodplain in developed areas
Ground Transportation Accident	• Park County • Livingston • Clyde Park	• Public meeting input • Subject matter expert input • Fire department records	• Heavily traveled Interstate 90 and Highway 89 traverse the county
Hazardous Materials Release	• Park County • Livingston • Clyde Park	• Park County Hazardous Material Plan • Public meeting input • Fire department records • US Coast Guard National Response Center	• Fixed facilities exist in the county that house hazardous materials • Regular interstate, highway, and railroad traffic transport hazardous materials • History of hazardous material releases
Railroad Accident	• Park County • Livingston	• Federal Railroad Administration database • Public meeting input	• Active railroad exists in the county and passes through Livingston • Several accidents have occurred in the past • Potential exists for a large hazardous materials release from a railroad accident
Severe Thunderstorms and Tornadoes	• Park County • Livingston • Clyde Park	• National Climatic Data Center database • National Weather Service website • Subject matter experts	• Severe thunderstorms, some causing damage, have occurred in recent history • Nearby history of F4 tornado
Terrorism, Civil Unrest, and Violence	• Park County • Livingston • Clyde Park	• Centers for Disease Control website • Park County Emergency Operations Plan • Southern Poverty Law Center website • Anti-Defamation League website	• Heightened alert since September 11, 2001 • Small scale incidents have occurred in Park County • Proximity to Yellowstone National Park and National Forest lands

Table 4.1 (continued) Hazards Identified in Park County, Livingston, and Clyde Park, Montana

Hazard	Jurisdiction	How Identified	Why Identified
Urban Fire	• Park County • Livingston • Clyde Park	• Historical fire records • Public meeting input	• Economic importance of downtown areas in Livingston and Gardiner
Utility Outage	• Park County • Livingston • Clyde Park	• Public meeting input • Subject matter experts	• Dependence of population on utility services
Volcano	• Park County • Livingston • Clyde Park	• Yellowstone Volcano Observatory • Montana Disaster and Emergency Services	• Proximity to active volcanic caldera • History of ash fall over the county
Wildfire	• Park County • Livingston • Clyde Park	• Park County records • DNRC records • USFS records	• Mountainous, forested, and flammable terrain exists throughout the county • History of significant wildfires, both forest and grass fires • Growth in the wildland/urban interface
Wind	• Park County • Livingston • Clyde Park	• National Climatic Data Center database • National Weather Service website	• History of hurricane force winds several times a year • Regular windy periods
Winter Storms and Extended Cold	• Park County • Livingston • Clyde Park	• Western Regional Climate Center database • Public meeting input	• History of road closures due to winter conditions • Potential for power outages during a cold spell

Assets and Community Inventory

An important piece of assessing the risk of the communities to the studied hazards is to recognize what assets are more vulnerable to those hazards than others. Identifying the assets in the communities is the first step in assessing the vulnerabilities to those assets. In many cases, once important facilities are identified, they can then be prioritized for mitigation. Examples of community assets include the population, critical facilities, government (publicly owned) facilities, businesses, residences, structures housing vulnerable populations, road and utility infrastructure, natural resources, and the economy. The most important facilities typically protect the continuity of government, the safety of the population, or the economy.

Critical Facilities

Two different types of critical facilities exist, those that are necessary to maintain essential community services, and those that house vulnerable populations. Those facilities that are considered vital to the community such as law enforcement, fire services, health services, communications, and other government services have been identified as **critical facilities**. Examples of facilities housing particularly vulnerable populations include elderly housing, schools, and jails. These facilities were identified at public meetings and through additional research and plan documents. The tables that follow specify the critical facilities and locations of vulnerable populations. Replacement values, where shown, are from the Park County Insurance Recapitulation Report prepared by Valuations Northwest, Inc. dated June 9, 2004. The total replacement value of all Park County buildings and

contents, including mobile equipment and equipment in vehicles, is estimated at $20,357,696. Time and resource constraints prohibited the collection of all values for all structures. Future development of this plan may allow for a more in-depth analysis. The critical facilities have been GPS mapped by the Park County GIS Department. A full sized map showing the critical facility and vulnerable population locations can be found in the Park County Disaster and Emergency Services Office or with the Park County GIS Department.

Table 4.2 Critical Facilities – Local Government/Law Enforcement

Name	Address	Replacement Value
City/County Complex (*EOC, Law Enforcement, Jail, and Government Offices) Built in 1976; 28,429 square feet*	414 East Callender Street Livingston	$5,256, 237
Clyde Park Town Hall	516 Miles Avenue Clyde Park	
Gardiner Sheriff's Office	430 Main Street, Unit B Gardiner	$180,322
Park County Search and Rescue	70 Vista View Drive Livingston	$133,178
Cooke City Search and Rescue	202 Main Street West Cooke City	$17,512
Park County Fairgrounds	46 View Vista Drive Livingston	$2,654,155
Livingston Civic Center	229 River Drive Livingston	

Table 4.3 Critical Facilities - Fire and EMS Stations

Name	Address
Park County Rural Fire Station #1	304 East Park Street Livingston
Livingston Fire and Rescue Station Livingston Ambulance	414 East Callender Street Livingston
Cooke City/Silver Gate Fire Hall	202 Main Street West Cooke City
Gateway Hose Company #1	118 Highway 1 South Gardiner
Gardiner Ambulance Service	213 Main Street Gardiner
Paradise Valley Fire Station Paradise Valley Ambulance	1140 East River Road Emigrant
Mill Creek Fire Station	17 Chicory Road Emigrant
Clyde Park Rural Fire Station	411 Miles Avenue Clyde Park
Clyde Park Fire Station	514 Miles Avenue Clyde Park
Wilsall Fire Station	207 Elliot Street Wilsall

Table 4.4 Critical Facilities – Hospitals and Clinics

Name	Address
Livingston Memorial Hospital	504 South 13th Street Livingston
Park Clinic	1001 River Drive Livingston
Community Health Partners	126 South Main Street Livingston
Mammoth Clinic	Mammoth Hot Springs Yellowstone National Park

Table 4.5 Critical Facilities – Transportation

Name	Address
Montana Rail Link Yard and Shop Complex	704 East Gallatin Street Livingston
Mission Field Airport *Replacement Value = $835,154*	84 Airport Road Livingston
Gardiner Airport	Airport Road Gardiner
Wilsall Airport	4 miles Northwest of Wilsall
Paradise Valley Flying Y Ranch Airport	55 Runway Lane Livingston
Greyhound Bus Station	1500 East Callender Street Livingston

Table 4.6 Critical Facilities – Utility and Infrastructure Services

Name	Address	Replacement Value
Park Electric Cooperative Offices	5706 US Highway 89 South Livingston	
Northwestern Energy	4 Merrill Lane Livingston	
Qwest	302 West Callender Street Livingston	
Transfer Station	328 North M Street Livingston	
Landfill	39 Chicken Creek Road Livingston	$41,018
Cooke City Compactor	Forest Service – Woody Creek Cooke City	$128,742
Livingston City Streets Shop	406 Bennett Street Livingston	
Livingston Sewage Treatment Plant	316 Bennett Street Livingston	
Gardiner Water and Sewer	17 Airport Road Gardiner	$116,353
Clyde Park Water and Sewer	8 Brackett Creek Road Clyde Park	
Wilsall Water	Darling Street Wilsall	
Cooke City Water	Forest Service – Miller Creek Cooke City	
Silver Gate Water	US Highway 212 West Silver Gate	
County Road Shop	302 Elliot Street North Wilsall	$75,096
County Road Shop	107 First Avenue South Clyde Park	$49,278
County Road Shop	16 Airport Road Gardiner	$40,624
County Road Shop	23 Chicken Creek Road Livingston	$491,948
Clyde Park Reservoir	Cottonwood Bench Road Clyde Park	

Table 4.7 Critical Facilities – State Government

Name	Address
Montana Highway Patrol	414 East Callender Street Livingston
Montana Department of Health and Human Services	200 East Park Street Livingston
National Guard Armory/DES	24 Fleshman Creek Road Livingston
Montana Department of Transportation	2308 US Highway 89 North Wilsall
Montana Department of Transportation	1354 US Highway 10 West Livingston
Montana Department of Transportation	1668 US Highway 89 South Gardiner
Montana Fish, Wildlife & Parks	406 Chestnut Lane North Livingston

Table 4.8 Critical Facilities – Federal Government

Name	Address
National Park Service North Entrance of Yellowstone National Park	US Highway 89 South Gardiner
National Park Service Northeast Entrance of Yellowstone National Park	US Highway 212 West Silver Gate
US Post Office	310 Elliot Street North Wilsall
US Post Office	103 First Avenue North Clyde Park
US Post Office	105 North Second Street Livingston
US Post Office	230 Jefferson Street Livingston
US Post Office	8 Pray Road Pray
US Post Office	305 Story Road Emigrant
US Post Office	707 Scott Street West Gardiner
US Post Office	208 Main Street East Cooke City
US Post Office	109B Highway 212 West Silver Gate
US Department of Agriculture *US Forest Service, Farm Service*	5242 US Highway 89 South Livingston
US Department of Agriculture *US Forest Service*	805 Scott Street West Gardiner

Table 4.9 Vulnerable Populations – Assisted Living/Senior Housing

Name	Address
Evergreen Healthcare	510 South 14th Street Livingston
Frontier Personal Care Center	121 South 3rd Street Livingston
Diamond K Assisted Living	1200 West Montana Street Livingston
Senior Citizen Center *Replacement Value = $161,136*	109 West Lewis Street Livingston
Sherwood Inn Apartments	325 South Main Street Livingston
Miles Building Apartments	107 South 2nd Street Livingston
Timberline Apartments	1302 East Montana Street Livingston
New Horizons	1301 Wineglass Lane Livingston

Table 4.10 Vulnerable Populations – Schools

Name	Address
School District No. 4 Administrative Offices	132 South B Street Livingston
East Side Elementary, Sleeping Giant Middle School, & Special Needs	301 View Vista Drive Livingston
Washington School (after school programs)	315 North Eighth Street Livingston
Winnans Elementary School	1015 West Clark Street Livingston
Park Senior High	102 View Vista Drive Livingston
Rural School District Administrative Offices	414 East Callender Street Livingston
Pine Creek School	2575 East River Road Livingston
Arrowhead School	1489 East River Road Pray
Shields Valley Elementary District	308 Hannaford Street Wilsall
Shields Valley High School	405 First Street East Clyde Park
Gardiner School District	510 Stone Street Gardiner
Cooke City School	305 River Street Cooke City
Springdale School	102 First Street Springdale
Saint Mary's Parochial School	511 South F Street Livingston
Thomas More Elementary School	30 Sirius Drive Emigrant

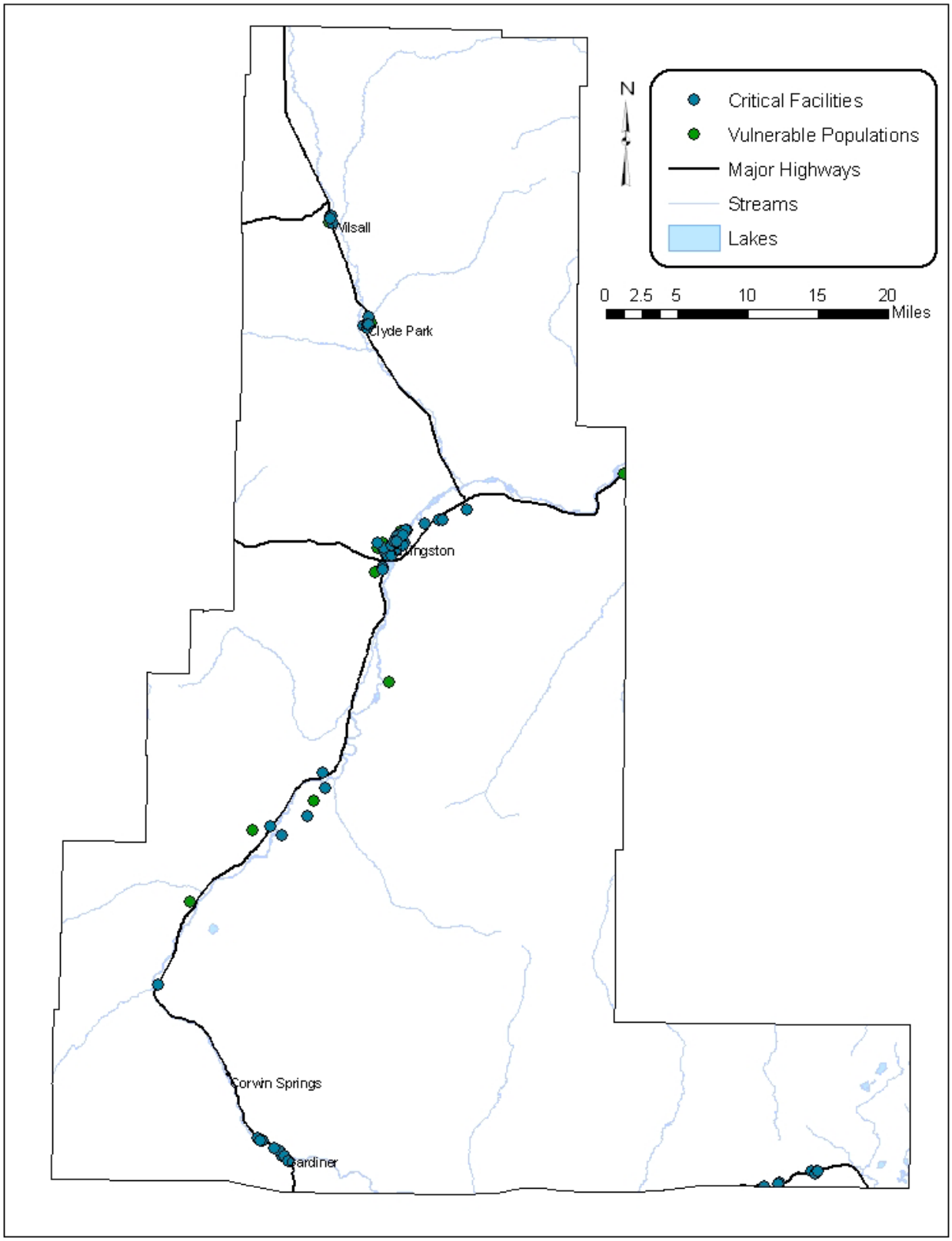
Table 4.11 Vulnerable Populations – Child Care/Day Care/Preschools

Name	Address
Head Start	201 South F Street Livingston
Learning Partners	113 West Lewis Street Livingston
Kids 'N Play *Capacity = 6*	111 ½ North E Street Livingston
Mountain Pine Preschool *Capacity = 26*	311 West Callender Street Livingston
Kelly's Play Palace *Capacity = 6*	605 East Milky Way Drive Livingston
Deborah Brenna *Capacity = 6*	106 South 6th Street Livingston
Jessica L. Roberts *Capacity = 6*	2321 Hwy 89 South Emigrant
The Looney Bin Day Care *Capacity = 12*	104 South C Street Livingston
Christina Goehring *Capacity = 6*	612 North 11th Street Livingston
Beverly Yager *Capacity = 6*	166 Paradise Drive Livingston
St. Mary's Preschool *Capacity = 35*	511 South F Street Livingston
Kid Connection *Capacity = 25*	216 South 9th Street Livingston
Jessie Sumner	119 North I Street Livingston

Table 4.12 Vulnerable Populations – Group Homes/Activity Centers

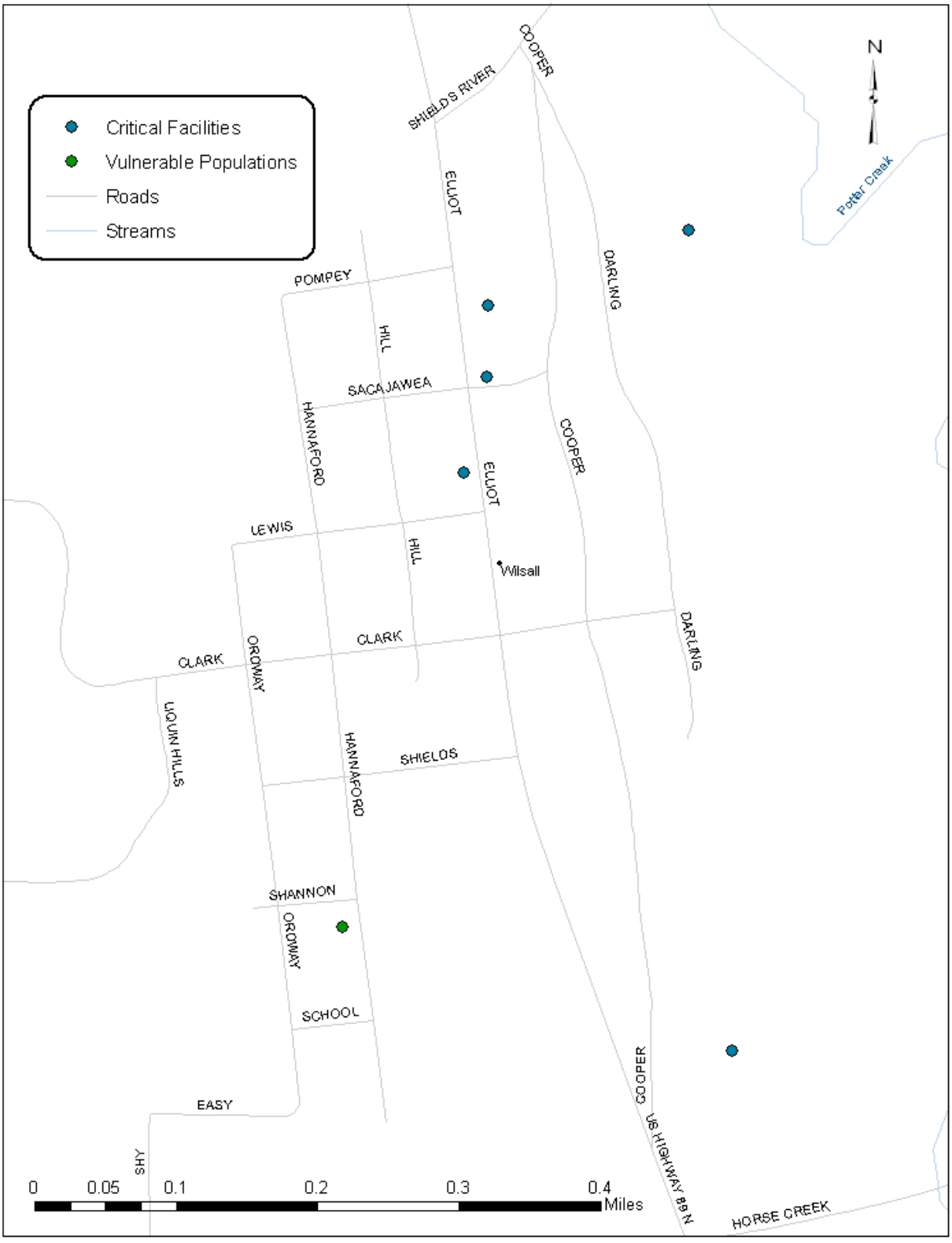
Name	Address
Counterpoint - Ninth Street Activity Center	629 North Ninth Street Livingston
Counterpoint - Milky Way Group Home	603 East Milky Way Livingston
Counterpoint – Lewis Street Group Home	116 East Lewis Street Livingston

Map 4.13 Park County Critical Facilities and Vulnerable Populations



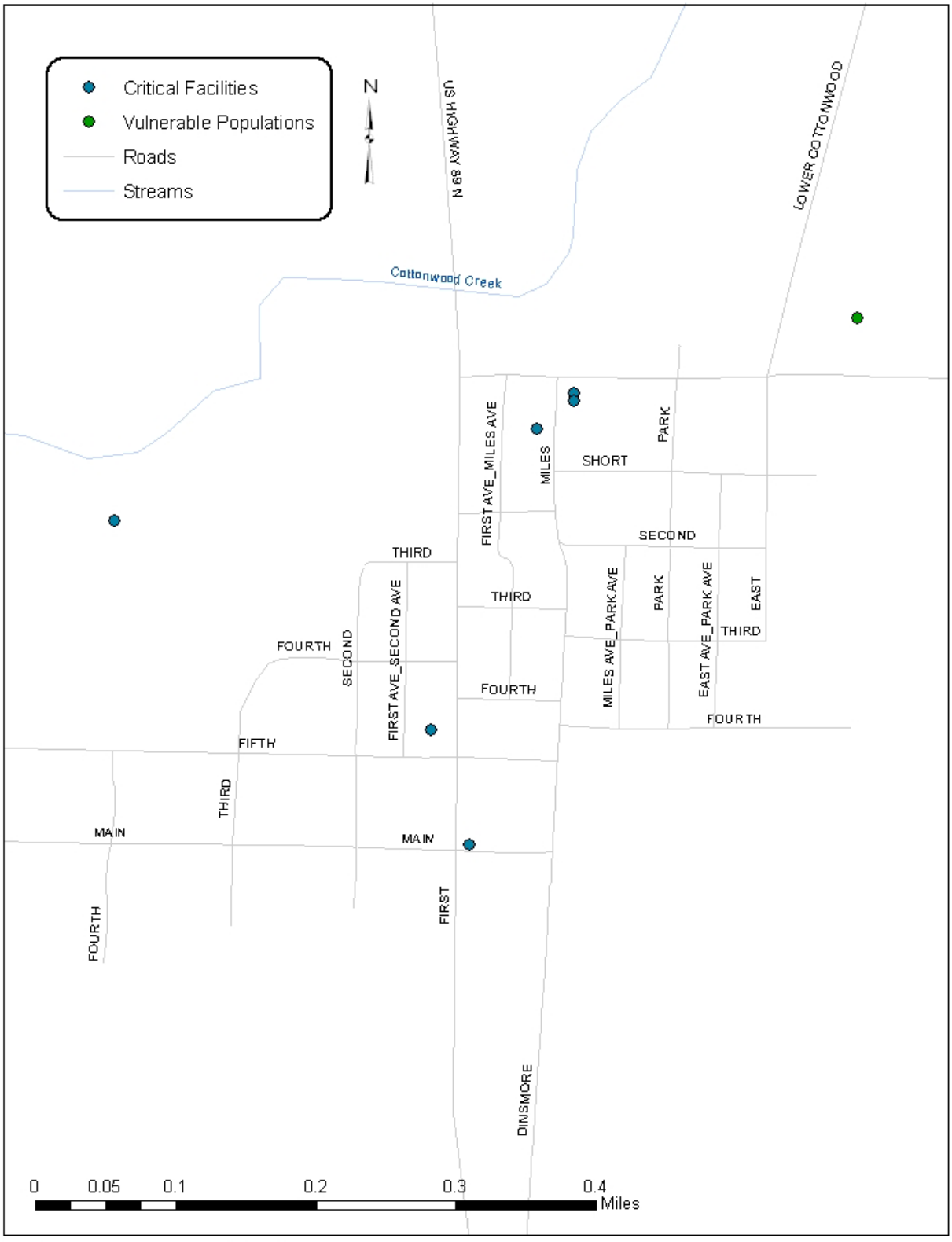
Data Source: Park County GIS, 2005

Map 4.14 Wilsall Critical Facilities and Vulnerable Populations



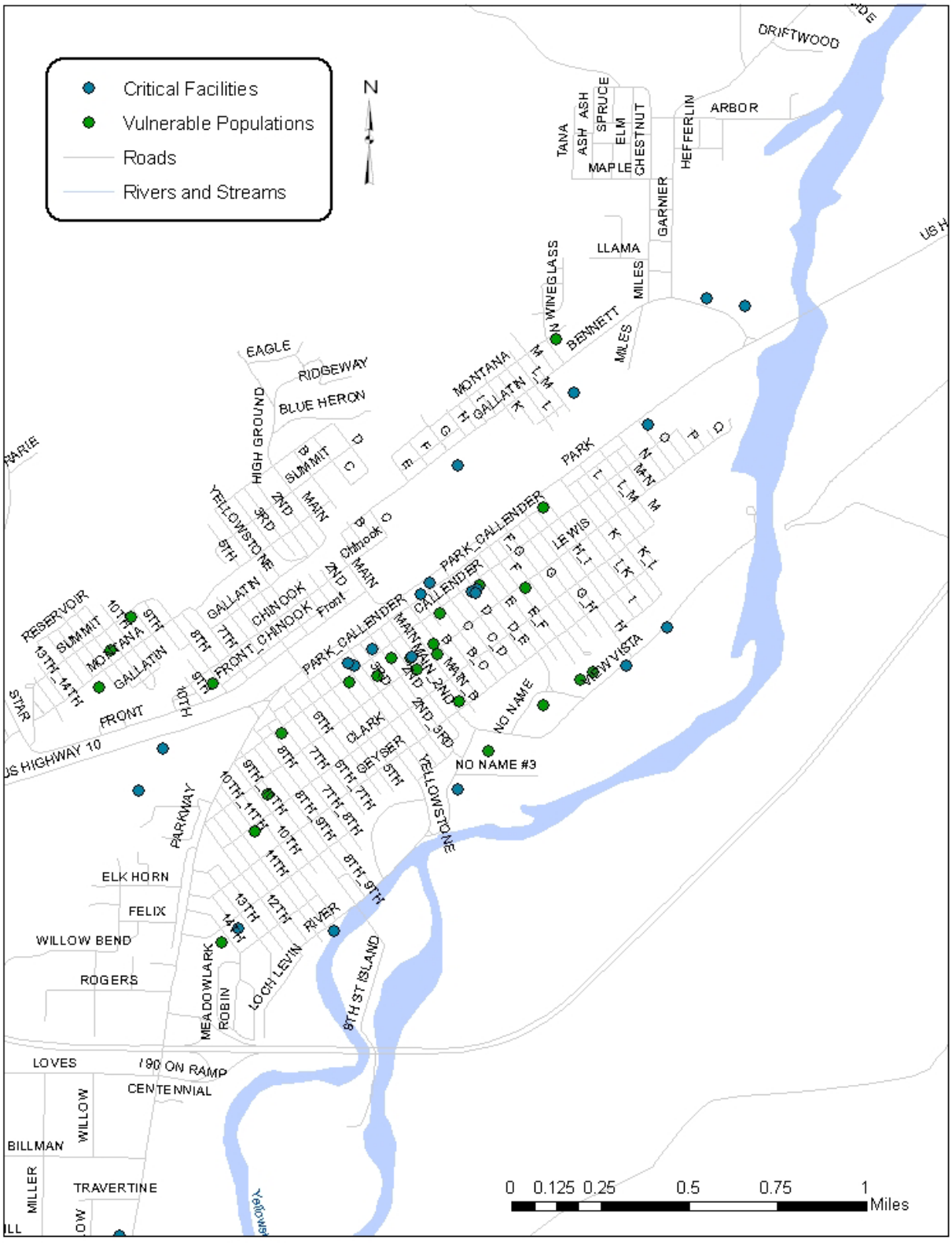
Data Source: Park County GIS, 2005

Map 4.15 Clyde Park Critical Facilities and Vulnerable Populations



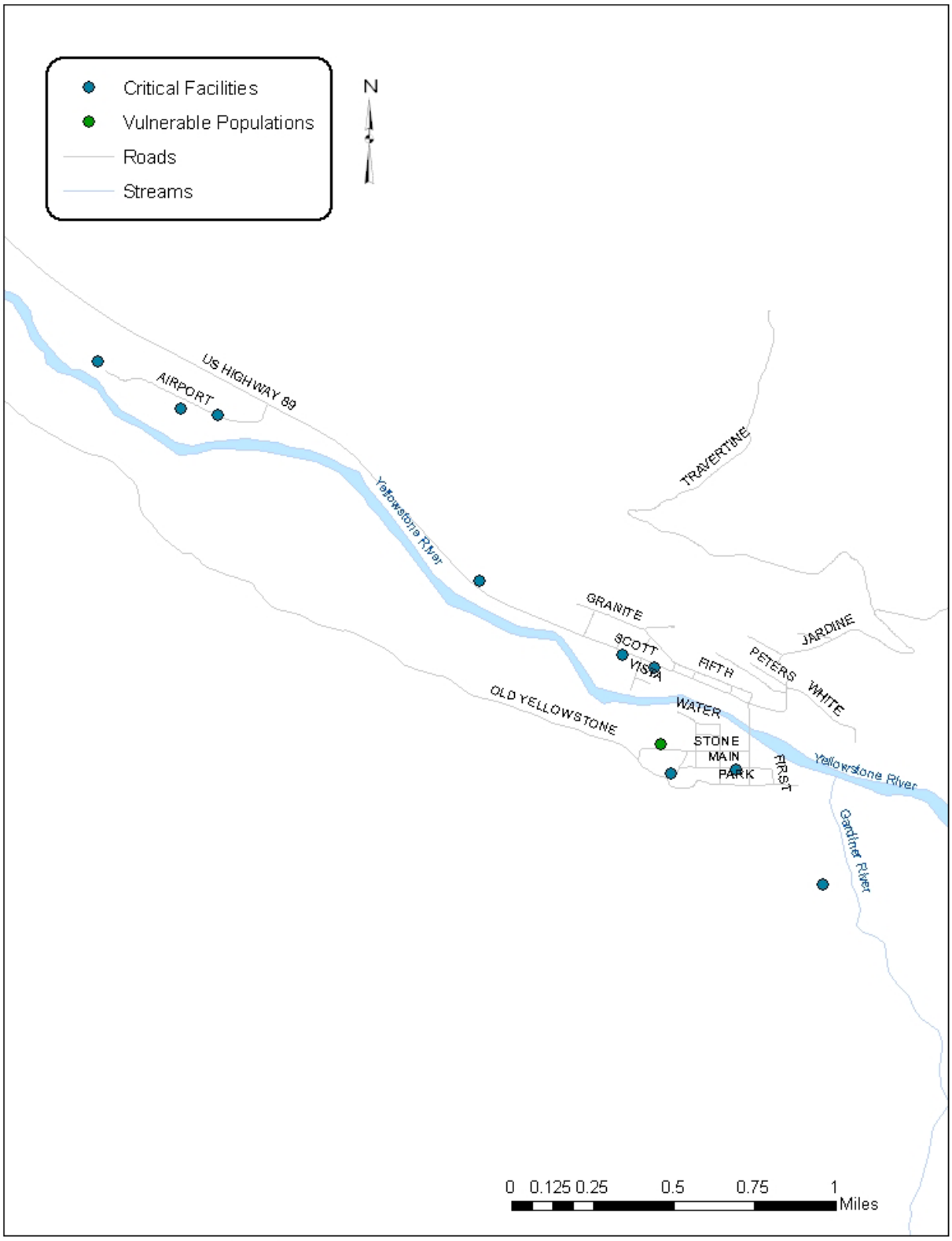
Data Source: Park County GIS, 2005

Map 4.16 Livingston Critical Facilities and Vulnerable Populations



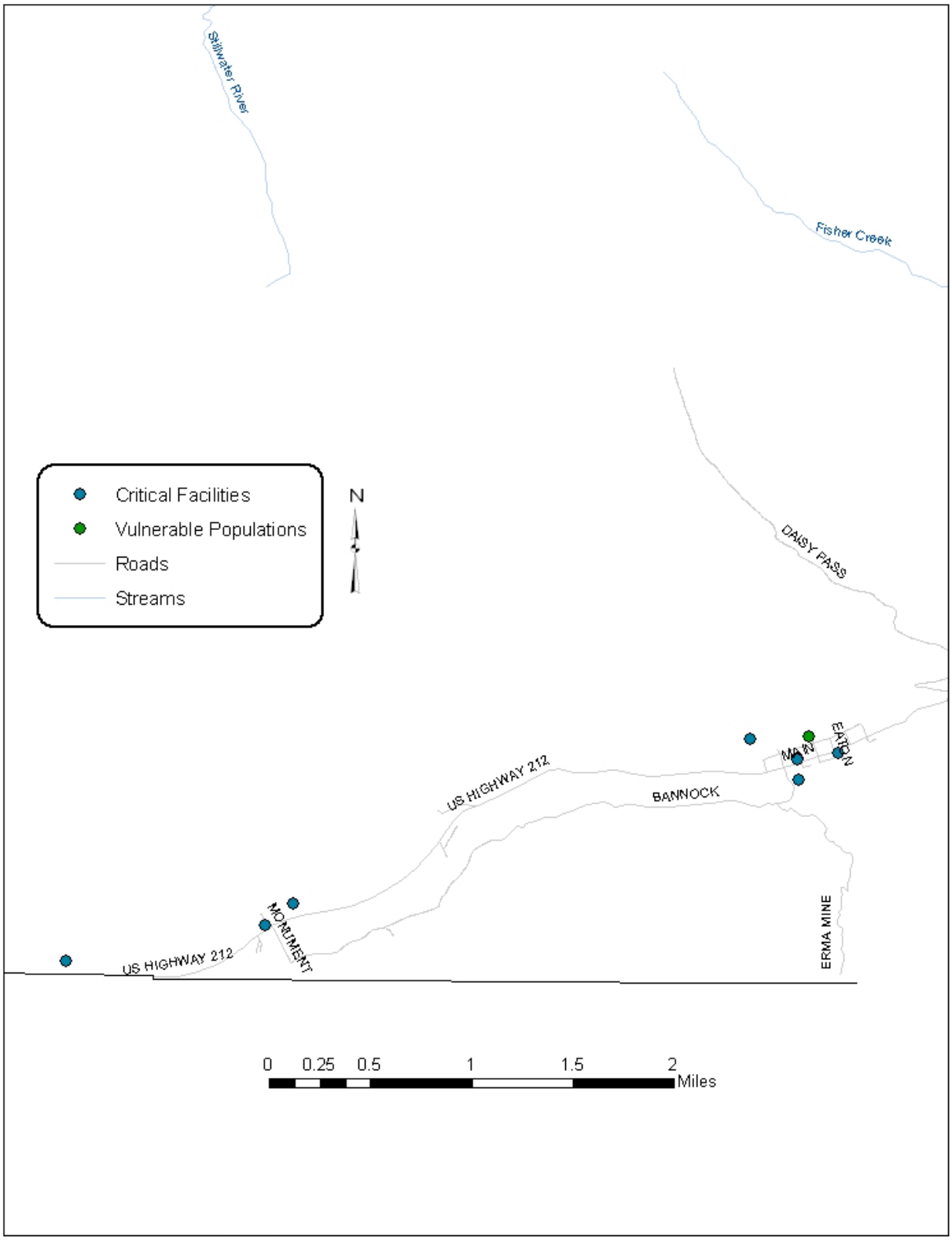
Data Source: Park County GIS, 2005

Map 4.17 Gardiner Critical Facilities and Vulnerable Populations



Data Source: Park County GIS, 2005

Map 4.18 Cooke City Critical Facilities and Vulnerable Populations



Data Source: Park County GIS, 2005

Buildings

In addition to the critical facilities, residences, businesses, and other facilities are also vulnerable to hazards. Based on 2000 US Census Data, the population of Park County is 15,694 with 8,247 housing units, including 157 in Clyde Park and 3,366 in Livingston. The median value of those owner-occupied housing units is $97,900. Also, 706 private, non-farm business establishments and 1,610 non-employer businesses exist. A further breakdown of the housing units can be found in Table 4.19

Table 4.19 2000 US Census Housing Data[6]

Units in Structure	Park County TOTAL	Livingston	Clyde Park	Unincorporated Areas of Park County
1-unit, detached	5,731	2,381	101	3,249
1-unit, attached	146	87	0	59
2 units	257	173	2	82
3 or 4 units	257	165	7	85
5 to 9 units	186	114	0	72
10 to 19 units	139	107	2	30
20 or more units	208	191	0	17
Mobile homes	1,307	148	47	1,112
Boats, RVs, vans, etc.	16	0	0	16
TOTAL	8,247	3,366	159	4,722
Year Structure Built	**Park County TOTAL**	**Livingston**	**Clyde Park**	**Unincorporated Areas of Park County**
1999 to March 2000	266	62	2	202
1995 to 1998	767	82	19	666
1990 to 1994	603	84	14	505
1980 to 1989	949	122	11	816
1970 to 1979	1,454	474	35	945
1960 to 1969	660	246	9	405
1940 to 1959	1,269	808	15	446
1939 or earlier	2,279	1,488	54	737
TOTAL	8,247	3,366	159	4,722

[6] Montana Department of Commerce, Census and Economic Information Center, October 2004. http://ceic.commerce.state.mt.us/demogProCty.htm

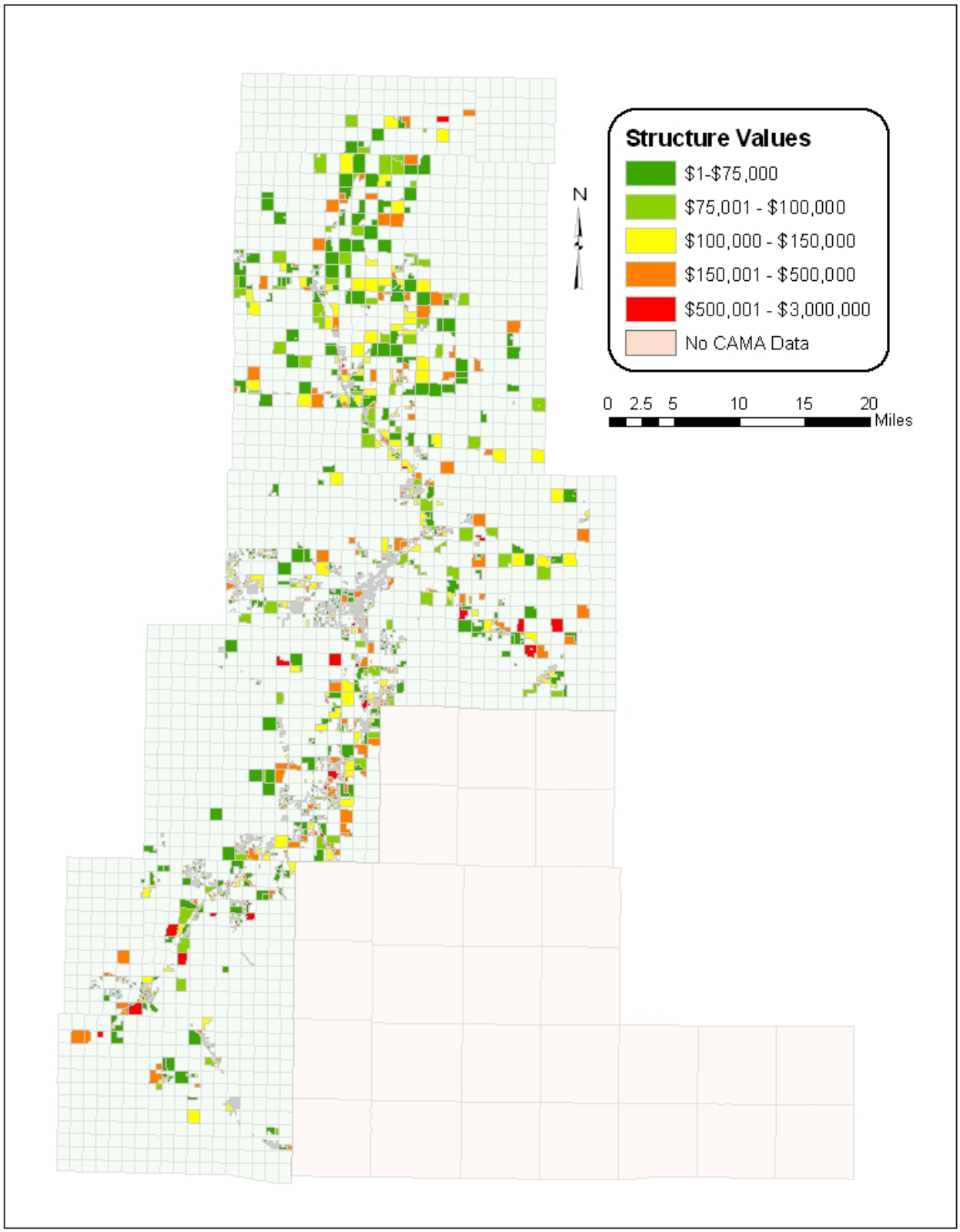
Table 4.19 (continued) 2000 US Census Housing Data[6]

Value of Owner Occupied Units	Park County TOTAL	Livingston	Clyde Park	Unincorporated Areas of Park County
Less than $50,000	133	80	7	46
$50,000 to $99,999	1,271	1,011	36	224
$100,000 to $149,999	676	346	7	323
$150,000 to $199,999	377	159	6	212
$200,000 to $299,999	179	20	2	157
$300,000 to $499,999	45	10	0	35
$500,000 to $999,999	6	0	0	6
$1,000,000 or more	14	0	0	14
MEDIAN	$97,900	$87,500	$85,800	$105,700

Using this census data, the total value of residential structures in Park County can be estimated at $807,381,300 (8,247 housing units * $97,900/unit). Breaking down the different areas in Park County, the value of the building stock in Livingston is estimated at $294,525,000, in Clyde Park at $13,642,200, and in unincorporated areas of Park County at $499,115,400.

As of April 2005, the structures in Park County are in the process of being mapped into a Geographic Information System. This preliminary dataset, approximately 50% complete, was used in vulnerability assessments where useful. As this dataset is completed, potential loss sections can be updated. Another database used to analyze vulnerabilities was the Montana Department of Revenue's Computer Assisted Mass Appraisal System (CAMA). This database shows the parcels of land and the associated taxable land and building values. Map 4.20 shows the parcels with building values greater than $0. The sum of the structure values (not including land values) assessed in Park County is $569,251,637. In comparison, the Federal Emergency Management Agency's HAZUS-MH loss estimation software gives the building stock in Park County a replacement value of $1,123,000,000.

Map 4.20 Park County Land Parcels with Structures



Data Source: Montana Department of Revenue Computer Assisted Mass Appraisal (CAMA) Database 2004

Infrastructure

In terms of infrastructure, very limited data exists outlining the specific infrastructure within the county. Electric transmission and natural gas lines are operated by Northwestern Energy and Park Electric Cooperative and telephone lines are operated by Qwest. Several cellular telephone towers are also present and are owned by various entities. For security purposes, mapping of the electric, communications, and natural gas infrastructure is not provided. The major roadways in Park County and most of the roads and bridges within Livingston are paved. Outside roads, however, are frequently gravel. Park County maintains 1,152 miles of roads and bridges.[2]

Public and community water supplies are common throughout Park County. Table 4.6 in the Critical Facilities section lists the major water systems in the county for the larger communities. Many subdivisions and housing developments additionally have their own systems based on demand and water quality control needs.

Three major regional electric transmission lines traverse Park County, two from east to west over the northern third of the county and one from north to south along the western half of the county. The Yellowstone Pipeline, a major pipeline transporting refined petroleum products from Billings, Montana to Spokane, Washington crosses the northern half of the county.

Economy

The Park County economy is driven by the tourism associated with Yellowstone National Park and outdoor recreation. Table 4.21 shows the 1997 Economic Census data for Park County.

Table 4.21 1997 Economic Census Data for Park County, Montana[7]*

Description	Number of Establishments	Sales, Receipts, or Shipments
Retail trade	111	$102,670,000
Manufacturing	36	$63,337,000
Accommodation & food services	111	$33,953,000
Wholesale trade	23	$33,903,000
Health care and social assistance	31	$13,757,000
Other services (except public administration)	35	$9,141,000
Professional, scientific, and technical services	46	$7,432,000
Real estate, rental, and leasing	28	$6,223,000
Arts, entertainment, and recreation	26	$4,281,000
Administrative, support, waste management, and remediation services	21	$2,240,000
Education services	2	Not available

*Note, not all industries are published at the county level.

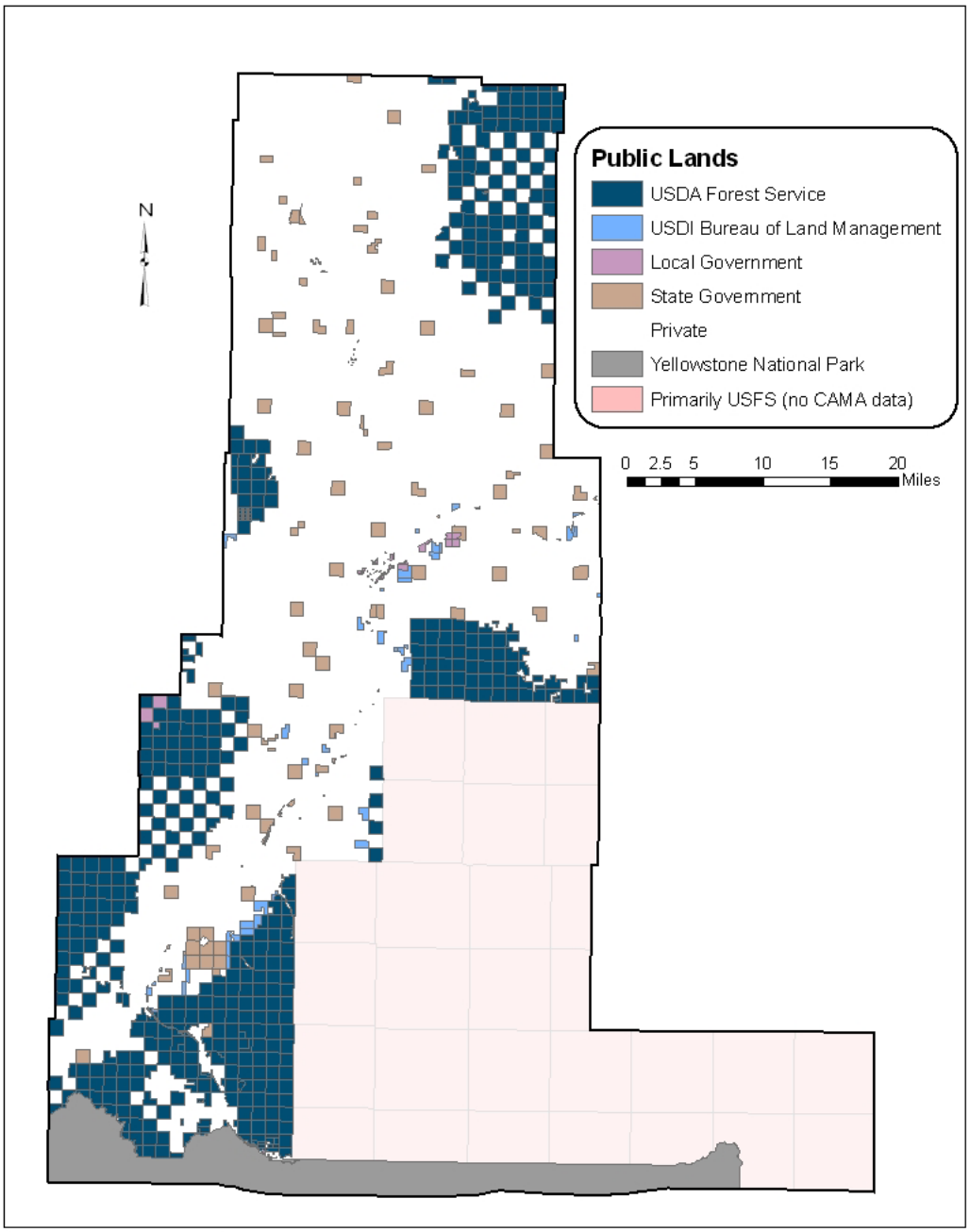
According to the Local Emergency Planning Committee (LEPC), Livingston Health Care, the owner and operator of the hospital and clinics in Park County, is the largest employer in the county and School District #2 is the second largest. The LEPC specifically notes the sectors involving tourism, internet-based businesses, timber, railroad services, and government drive the economy.

[7] US Census Bureau, October 2004. http://www.census.gov/econ/census02/

Land Use and Future Development

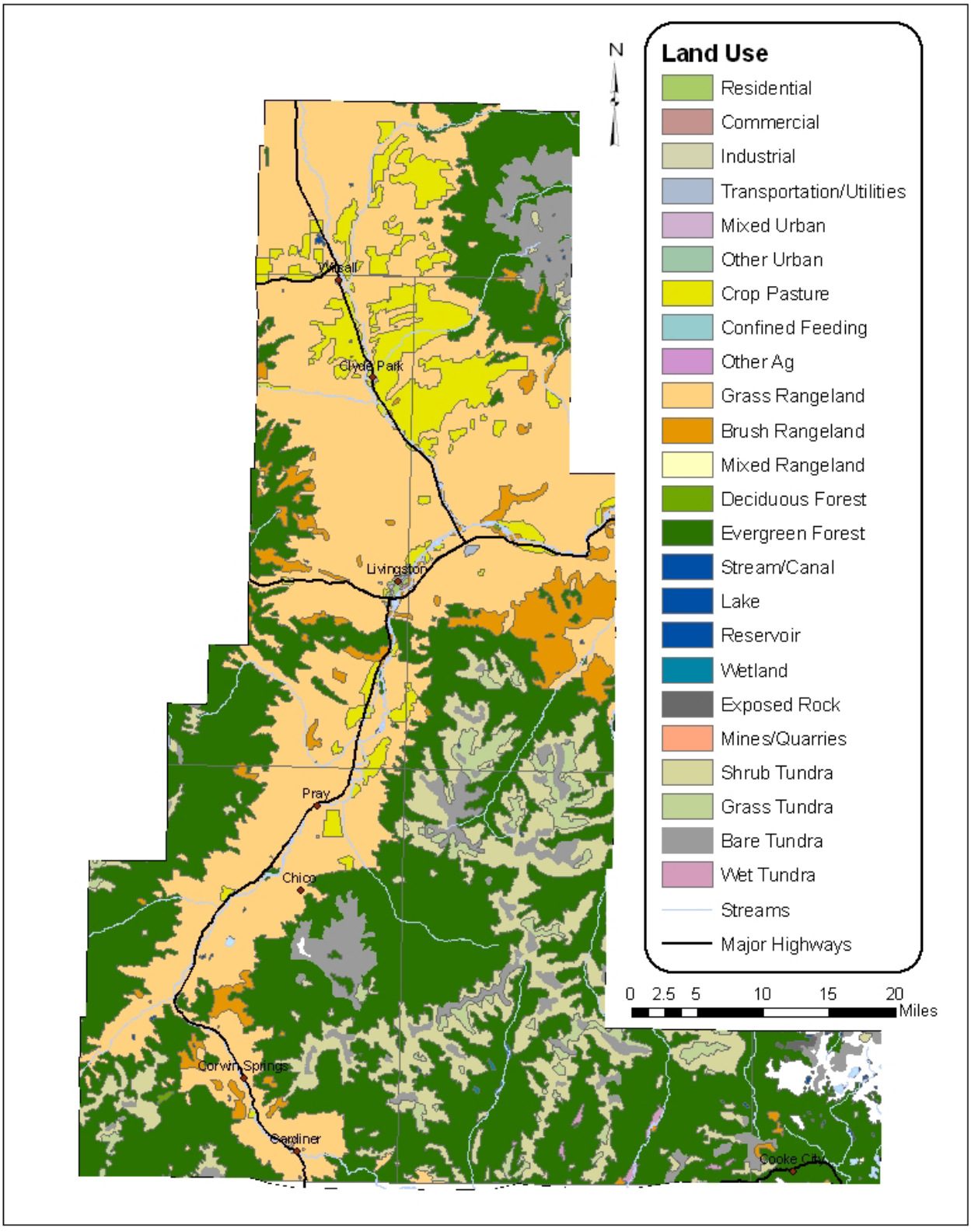
Park County is just one of many counties in Montana experiencing community growth and the regular creation of subdivisions. The Park County Planner estimates up to 3,500 new homes could be built within the next five years. Park County's current land use is a wide variety of agricultural, forest, and residential uses. Map 4.22 shows the government land ownership in the county. Map 4.23 shows the general land use.

Map 4.22 Public Lands in Park County



Data Source: Montana Department of Revenue Computer Assisted Mass Appraisal (CAMA) Database 2004

Map 4.23 Park County Land Use



Data Source: US Geological Survey, Montana State Library

Growth Policy

At the time of this plan's development, a countywide growth policy was in draft form. A growth policy is required by Montana law for changes to be made to zoning and development regulations. The growth policies do not have regulatory authority but guide community development regulations and ultimately replace comprehensive plans. The draft Park County Growth Policy applies to the parts of Park County that are not within the jurisdictions of the City of Livingston or the Town of Clyde Park. The document "outlines mechanisms and processes to provide for the management of future development growth in Park County. Because of increasing demand and rising land values, it is assumed that growth will continue and that land previously used for agriculture or other purposes will continue to be developed. The growth policy provides a framework for guiding how that development occurs."[8] The following are descriptions of the various areas in Park County, as summarized from the draft growth policy:

Clyde Park Area

The Clyde Park area, north of Livingston, is mostly agricultural land use with 90% of the land privately owned as of 1998. This rural area is expected to experience growth if current trends continue.

Cooke City Area

The Cooke City/Silver Gate area is in an isolated part of the county in a narrow valley. The area has two access points, both through Wyoming. Two hours from the county seat, the year-round access is through Yellowstone National Park. The scenic Beartooth Highway to Red Lodge is only open during the summer when the population expands by 300-400%.

Gardiner Area

Gardiner is the gateway community to the very popular North Entrance of Yellowstone National Park and is home to roughly 2,400 seasonal employees. Although the majority of the land in this area is publicly owned, some mining land could be sold for development.

Livingston Area

Livingston is the largest city and serves as the county seat. The city itself is a mix of residential, industrial, and commercial land use. The area outside the city limits, included in the Park County Growth Policy, is more agricultural in nature and is currently experiencing growth. This area is currently zoned and managed through the Livingston Neighborhood Plan.

Paradise Valley/Cokedale Area

The Paradise Valley and Cokedale area, located south and west of Livingston, is currently experiencing growth as agricultural land is being residentially developed. Most of the growth population is seasonal and is located away from community centers.

Springdale Area

The Springdale area, east of Livingston, is primarily used for agriculture. As of 1998, ownership was roughly 44% private and 56% public. Zoning was in place to limit development but those regulations have since been overturned.

[8] Draft Park County Growth Plan, http://www.parkcounty.org/Growth/growth.html. June 2005.

Wilsall Area
Wilsall, north of Clyde Park, is primarily agricultural land use with 75% under private ownership. This area is somewhat isolated from growth at this time because of its distance from larger city areas.

Vision and goals adopted in the draft growth policy show some support for mitigation measures. For example, part of the community vision is to, "Conserve and protect basic resources such as the Yellowstone River, Shields River, Soda Butte Creek, and other water resources; land; air; wildlife; and scenery." Overall, the growth policy supports hazard mitigation through the following goals, objectives, and implementation measures: the retention of agricultural lands through voluntary conservation easements and a land trust fund, a permit system or similar measure to ensure development is compatible with public safety needs, and conservation of surface and ground water and quality. Specific to flooding, the policy advises the protection of rivers from development related impacts through the adoption of the new Yellowstone River floodplain mapping, river setback regulations, prohibition of development in the floodplain, proper bridge design, and removal of abandoned bridge abutments and piers. Specific to wildfire, the policy emphasizes the provision of a reasonable level of fire protection for residents and property owners through defensible space and inspection of new development in the wildland urban interface, consideration of water supplies, fuels mapping, and Firewise type programs.

<u>City-County Zoning Resolution</u>
The City-County Zoning Resolution, adopted in 1997, establishes zoning requirements for the immediate area surrounding Livingston outside the city limits, also known as the "donut" area. This resolution provides mitigation for a number of hazards:

Flooding:
- Driveways must be adequate for storm drainage.
- No development (unless agriculture) can occur in the floodway.

Wildfire:
- Roadways must be clear of slash.

Wind:
- Homes in mobile home parks must be tied down.

<u>Park County Subdivision Regulations</u>
The Park County Subdivision Regulations, revised June 1, 2004, applies to the division of parcels less than 160 acres. As stated in the document, part of the purpose of the regulations is, "to promote the public health, safety, and general welfare" including "the avoidance of danger or injury by reason of a natural hazard." In addition to the standards outlined in these regulations, all subdivisions must comply with any adopted Park County Zoning Regulations, Uniform Building Codes adopted by the State of Montana, the Uniform Fire Code, and the Park County Floodplain Regulations. Land that the governing body can deem unsuitable for subdivision without mitigation include hazardous areas subject to flooding, swelling soils, snow avalanches, rock falls, land slides, steep slopes in excess of 25% grade, subsidence, high water table, and emergency access limitations. Related to specific hazards, the following provisions have been stated:

Flooding:
- The minimum construction setback from the Yellowstone, Shields, and Boulder Rivers is 150 feet from the mean high water mark and 100 feet from all other perennial streams and lakes.
- Live stream drainage areas not identified on floodplain mapping must be surveyed and data submitted.
- Culverts should be sized to the maximum expected flow in fifty years at a given location.

Wildfire:

- Subdivisions must be in a fire district.
- Subdivisions must be reviewed by the fire department for compliance with required fire protection and prevention measures.
- Major subdivisions (more than 5 lots) must provide a year-round self replenishing central water supply either on-site or within one mile with a minimum flow of 250 gpm for 2 hours.
- Minor subdivisions (5 lots or less) must have a water supply of at least 2,500 gallons per lot on site with an approved hydrant system, a developed water source with 250 gpm for 20 minutes within 2 miles (or less if in a high wildfire hazard area), or automatic sprinkler systems.
- High wildland fire areas are considered to be heads of draws, excessive slopes, dense forest growth, or other hazardous wildfire components, and the planning board may designate the homesite on the parcel to minimize the threat.
- Subdivision covenants in high wildland fire areas must recommend new lot owners contact the fire department or planning office for Firewise building and landscape practices.

Vulnerability Assessment Methodology

The vulnerability assessment methodology used a combination of GIS analysis techniques and best estimates. Some hazards have digital data depicting the degree of risk across the countywide area and some do not. Where possible, the digital data was used. Otherwise, a plausible scenario was created, and based on community values, potential losses were estimated.

The Park County GIS department has created a GPS database of the critical facilities. These facilities were identified by the Local Emergency Planning Committee (LEPC). Park County GIS is also in the process of developing a detailed database of the structures in the county. Such a large undertaking takes time, and therefore, the structure layer that is ideal for assessing the vulnerability of community assets is not yet completed. Preliminary structure locations (about 50% complete) were used, where possible, to show the relationship of structures to hazard areas. Otherwise, the Montana Department of Revenue Computer Assisted Mass Appraisal System (CAMA) system was used to delineate what parcels of land had taxable structures on them. The CAMA data is also limited by the fact that it does not cover all of the county areas, nor does it locate where the structure or structures are on a given parcel. This database, however, does provide structure values for the parcels.

Whenever possible, the hazard area was overlaid on the structure/parcel data to determine the number of structures and the structure values that lie within that hazard area. In most cases, the dollar values are multiplied by a damage factor since many events will not result in a complete loss of all structures. Frequently, only parts of the hazard area are affected or structures don't suffer a complete loss and may have only minor damage. These figures, of course, will only represent estimates but are based on current hazard data. Whenever possible, losses were estimated based on factors listed in the FEMA publication, *State and Local Mitigation Planning How-to Guide: Understanding Your Risks*.

The population impacts were qualitatively assessed based on the percentage of the population estimated to have residences in the hazard area and the general warning time that could be expected. The loss of life and possible injuries are difficult to determine and would be dependent on the time of day, event location, and hazard specific circumstances.

The vulnerability of future development was determined through a comparison of the high risk areas for each hazard and the expected growth for those areas. Resources such as the county growth policy, subdivision regulations, and population estimates were used where possible. The impact of future development was also determined based on the ability to mitigate damages during the planning and construction phases of the development and the community provisions in place to do so.

Hazard Profiles

AVALANCHE and LANDSLIDE

Description

Avalanches and landslides are similar in nature such that both occur when a material on the surface of the earth cannot be supported any longer and gives way to gravity. In the case of an avalanche, the substance is snow, and for a landslide, the substance is mud, rock, or other geologic material. Both can occur rapidly with little warning.

When snow accumulations on a slope cannot be supported any longer, the snow support structure may break and fall creating an avalanche. The subsequent rush of unsupported snow can bury and move things in its path. The majority of avalanches do not cause any damage; occasionally however, people and property may fall in their paths.

According to the Montana Disaster and Emergency Services website, "If it is assumed that an accumulation of snow is possible anywhere in Montana, then we can evaluate the potential for hazard solely on the basis of terrain characteristics. The most important factor by far is terrain steepness. Wet snow avalanches can start on slopes of 20 degrees or less, but the optimum slope angle for avalanche starting zones is 25-45 degrees. Slopes steeper than 45 degrees will not normally retain enough snow to generate large avalanches, but they may produce small sluffs that trigger major avalanches on the slopes below. Therefore, all slopes of 20 degrees and greater should be considered as potential avalanche sites."[9]

In the case of landslides, some landslides move slowly and cause damage gradually, whereas others move so rapidly that they can destroy property and take lives suddenly and unexpectedly. Gravity is the force driving landslide movement. Factors that allow the force of gravity to overcome the resistance of earth material to landslide movement include: saturation by water, steepening of slopes by erosion or construction, alternate freezing or thawing, earthquake shaking, and volcanic eruptions. Landslides are typically associated with periods of heavy rainfall or rapid snow melt and tend to worsen the effects of flooding that often accompanies these events. In areas burned by forest and brush fires, a lower threshold of precipitation may initiate landslides.[10]

History

The history of avalanches in Park County is much more pronounced than that of landslides. Both, however, have occurred. Table 4.24 outlines the impacts of avalanches since 1998. Note that avalanches are a normal occurrence in Park County and typically do not cause any damages. The only concerns here are when people or property lie in the path.

[9] Montana Disaster and Emergency Services, http://discoveringmontana.com/dma/des/.
[10] Federal Emergency Management Agency, www.fema.gov.

Table 4.24 Park County Avalanches Impacting the Population 1998-2003[11]

Date and Location	Result
January 11, 1998 Rock Creek, 35 miles South of Livingston	One snowmobiler completely buried but rescued
January 19, 1998 Scotch Bonnet Mountain near Cooke City	Three snowmobilers killed and one injured
March 26, 1998 Scotch Bonnet Mountain near Cooke City	One snowmobiler completely buried but rescued
December 26, 2000 Daisy Pass near Cooke City	One snowmobiler caught but rescued
December 31, 2000 Emigrant Peak, Absaroka Range	Two hikers killed and one injured
January 27, 2002 Miller Creek, outside of Cooke City	One snowmobiler injured after being completely buried
February 16, 2002 Mount Abundance, north of Cooke City	Two snowmobilers killed
December 28-29, 2002	Four separate snowmobile avalanche incidents, one with a serious injury
January 22, 2003 North Side of Wolverine Peak near Cooke City	One snowmobiler killed
February 2, 2003 Elk Creek Drainage of Crazy Mountains near Livingston	One snowmobiler killed
March 9, 2003 Mount Abundance, 10 miles Northwest of Cooke City	One snowmobiler killed

Since 1998, 10 people have been killed by avalanches in Park County with numerous additional injuries and close calls. Of the 10 fatalities, 8 have been from snowmobilers and 2 from hikers. The Cooke City area also has historically had more incidents than other parts of the county.

Significant landslides have not been documented in Park County, however, small ones are generally known to have occurred in Yankee Jim Canyon. The 1935 Helena earthquakes triggered a landslide 24 miles south of Livingston on the east side of the Yellowstone River burying the roadway and telephone lines. The road was cleared the following day.[12] Despite the numerous relatively minor incidents in Park County from avalanches and landslides, none were declared state or federal disasters.

Probability

The Colorado Avalanche Information Center has compiled statistics on a statewide basis on avalanche fatalities. Montana ranks fifth in the nation with over 50 fatalities from 1950/51 to 2000/01. Looking at the activities the individuals were undertaking at the time of the avalanche, climbing, backcountry skiing, and snowmobiling rank as the top three. Ratings have not been complied for counties within Montana, however, the historical databases show that Park County is one of the more vulnerable counties in the State from avalanche, particularly in the Cooke City area. Based on the statistics from 1998-2003, an average 1.7 people (10 fatalities/6 years) are killed in Park County from avalanches

[11] Information compiled from the Avalanche.org database, www.avalanche.org, includes information documented by the Gallatin National Forest Avalanche Center, the Bozeman Daily Chronicle, and the Associated Press.
[12] Helena Independent, October 22, 1935.

each year. The history of significant incidents noted in Table 4.24 demonstrates that the population is most vulnerable to avalanches during the months of December, January, February, and March.

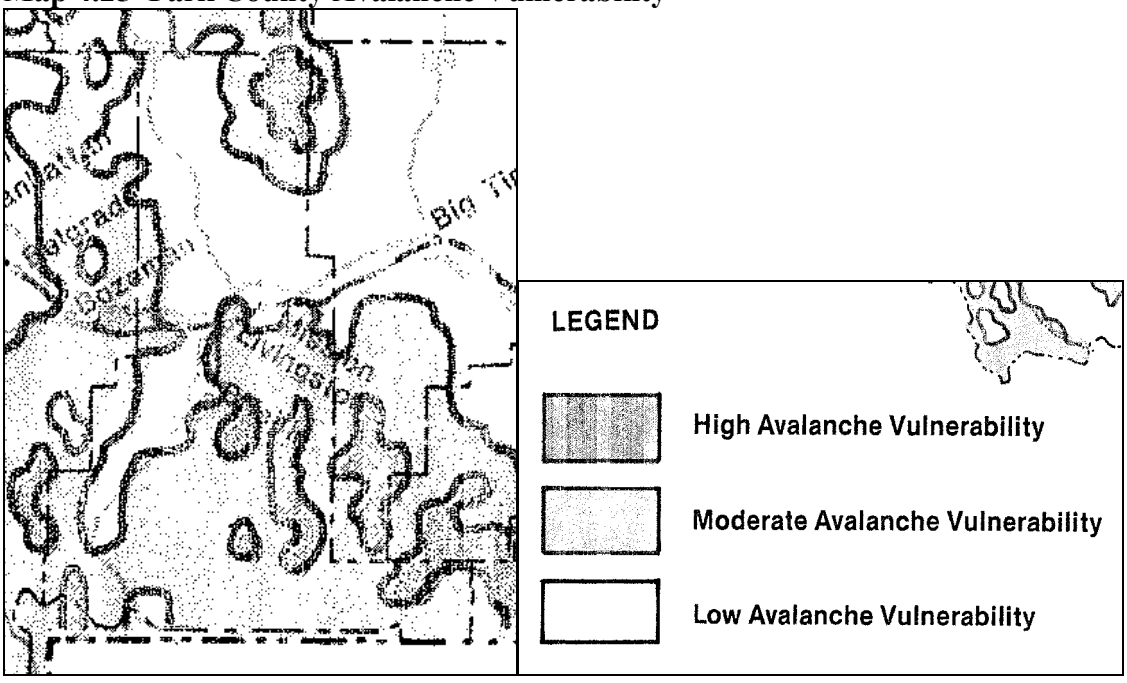
Landslides have an even lower probability of creating a disaster based on a very limited history of events. Should landslides occur in this area, they typically do not affect life or property. The probability of a damaging landslide could greatly increase if development were to occur in landslide prone areas. Wildfire burn areas also greatly increase the probability of a landslide triggered by precipitation.

The probability of an avalanche or landslide to cause enough damage for a county, state, or federal disaster is considered low based on the historical record.

Mapping

A map titled Vulnerability to Avalanches in Montana published in the Montana Hazard/Vulnerability Analysis from 1987 shows the very general areas within Montana that are considered vulnerable to avalanches. Map 4.25 shows an electronically scanned version of the legend and map zoomed to Park County. Although somewhat difficult to read, the map shows the southern half and northeast corner of Park County to be at greatest risk for avalanches. These areas coincide with the mountainous regions of the county.

Map 4.25 Park County Avalanche Vulnerability[13]

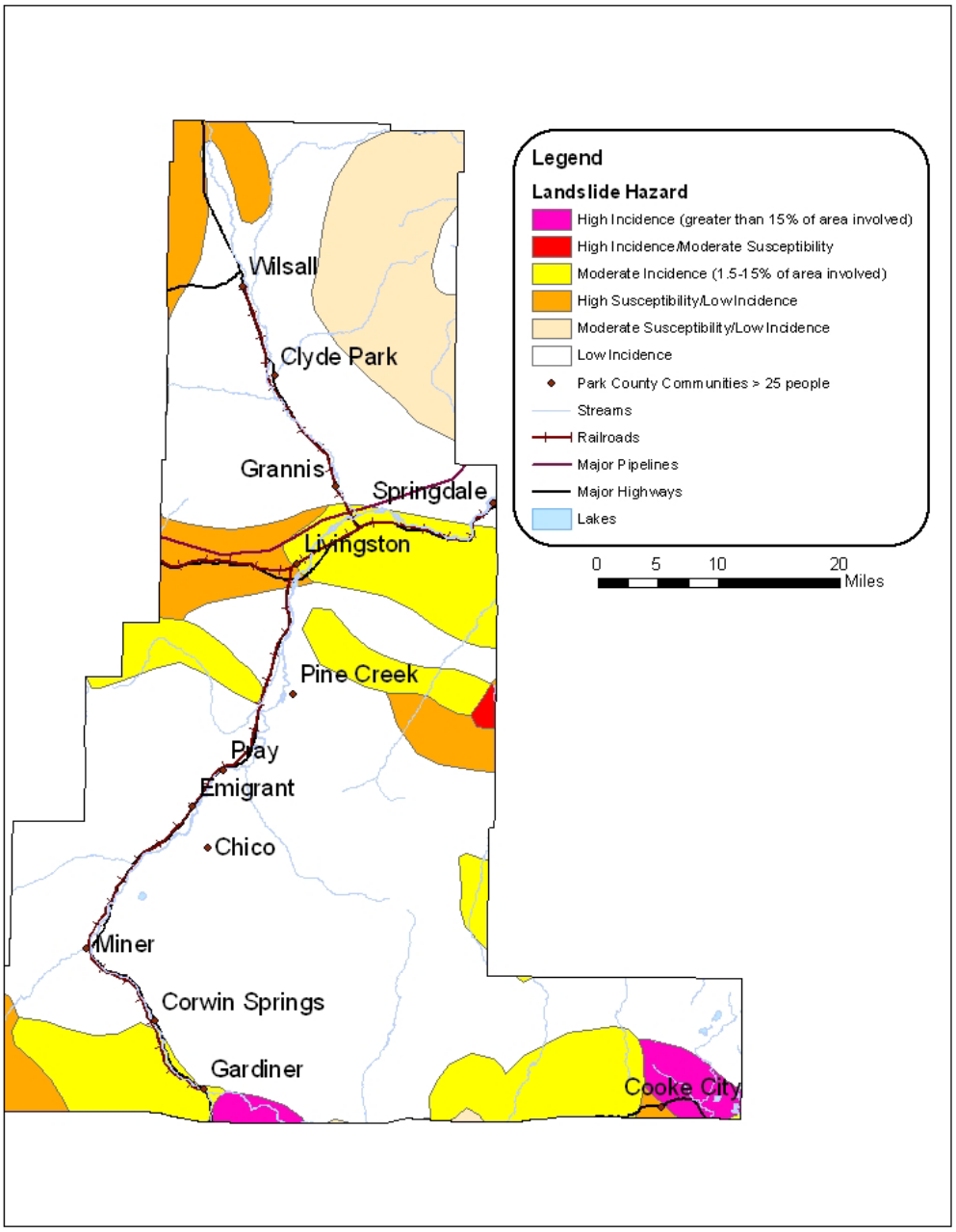


Landslides, due to their site specific nature, are another hazard difficult to map. A national map has been produced by the US Geological Survey as part of a study. This study, USGS Open-File Report 97-289 by Jonathan W. Godt, looked at incidence and susceptibility of landslides on a nationwide

[13] Montana Disaster and Emergency Services, Montana Hazard/Vulnerability Analysis, Vulnerability to Avalanche in Montana, 1987.

basis. Therefore, the areas identified are general and not exact on the county scale. The following is noted in the USGS study, "Susceptibility is not indicated where same or lower than incidence. Susceptibility to landsliding was defined as the probable degree of response of [the areal] rocks and soils to natural or artificial cutting or loading of slopes, or to anomalously high precipitation. High, moderate, and low susceptibility are delimited by the same percentages used in classifying the incidence of landsliding. Some generalization was necessary at this scale, and several small areas of high incidence and susceptibility were slightly exaggerated." Map 4.26 shows these areas for Park County.

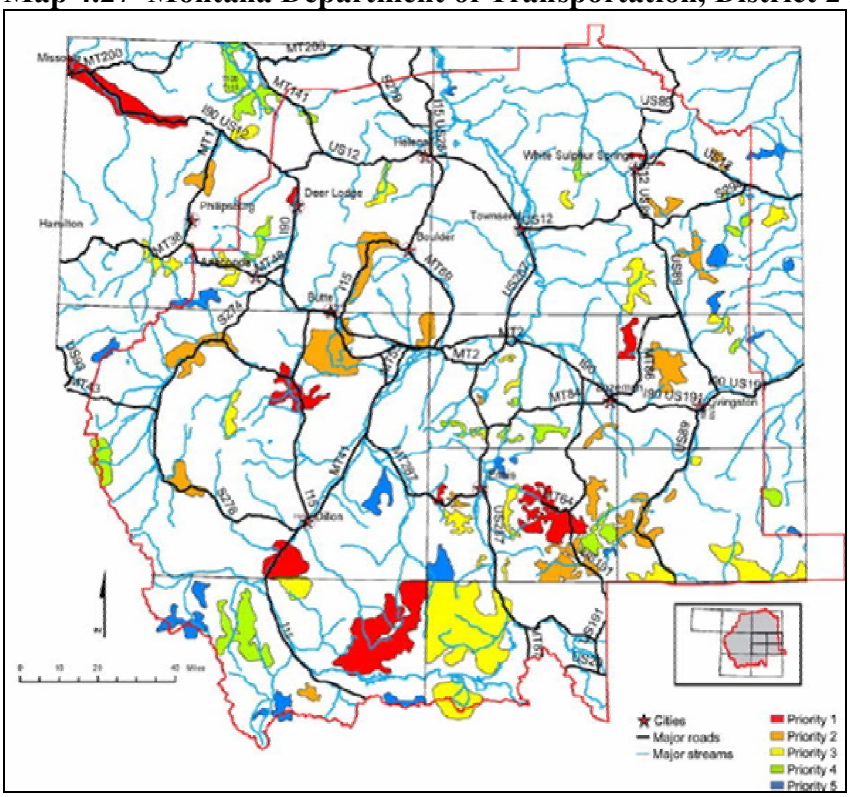
Map 4.26 Park County Landslide Hazard Areas



Data Source: US Geological Survey

The Montana Department of Transportation, District 2 has mapped the priority areas for landslide mitigation. The determination of priorities was based on an inventory of landslides and their proximity to state highways. Park County, the southeastern section of District in Map 4.27, has several Priority 2 and 3 areas.

Map 4.27 Montana Department of Transportation, District 2 Landslide Priority Areas[5]



Associated Hazards and Other Factors

Avalanches often occur independently from other hazards but can occasionally be linked to significant winter storms and high wind events. During years of heavy snowfall and increased incidence of avalanches, a rapid snowmelt can then lead to flooding. Landslides can be linked to several different hazards. Following a wildfire, the burnt area can often be very prone to landslides, particularly when combined with heavy rainfall. In fact, given enough rainfall, landslides and the associated mudflows can occur almost anywhere and are typically partnered with flash flooding off of mountainous areas. The massive Hebgen Lake landslide in nearby Madison County was triggered by a strong earthquake. This potential also exists in Park County.

Vulnerability

Critical Facilities

Critical facilities in Park County historically have not suffered losses or been threatened by avalanches or landslides. Not that a critical facility could not be impacted, but the probability is very low. Most facilities are located outside of steep slope areas. The primary exceptions are roadways and communications equipment. Some sections of state highways and county roads are known to have possible landslide hazards, as shown in Map 4.27. Typically, communications equipment, such as radio towers, are located on mountain peaks and are somewhat protected due to their locations near the peaks but not immune to avalanches and landslides. Potential losses to roadways and communications equipment could easily total into the hundreds of thousands of dollars, but the probability of such an event is considered low.

Potential Losses

Like critical facilities, potential losses to other structures is considered low. Most avalanche and landslide prone areas are located on federal or state lands and do not have significant numbers of structures. Therefore, the potential losses to structures is low.

The potential for economic losses is more likely yet probably not significant. An avalanche or landslide could destroy an area designated for logging, however, such an event may also create fallen timber for harvesting. With tourism being a very large part of the regional economy, severe avalanche seasons could have an impact on the snowmobiling economy. Although the potential for economic losses exists, the potential is not considered significant.

Potential Population Impacts

Based on records from the past 6 years, an average of 1.7 people are killed by avalanches in Park County each year. This figure shows that the greatest losses from avalanches are to human life. Fortunately, with advisories being issued by centers, such as the Gallatin National Forest Avalanche Center, some warning does exist as to the potential for avalanches. Training also educates outdoor enthusiasts on the signs of avalanche danger. The potential for population impacts from avalanches, especially when compared to other hazards, is still considered low. Related to landslides, the National Weather Service issues flash flood warnings during periods of rainfall or snow melt that have a high likelihood of causing flash flooding. Such flooding and rapid runoff may trigger land and mud slides. Without any documentation supporting any deaths or injuries from landslides in Park County, this potential is also considered low.

Impact of Future Development

Fortunately, most of the avalanche and landslide prone areas in Park County are within publicly owned lands. Should development on private land coincide with avalanche or landslide areas, however, the impact of future development could have negative consequences on life and property. Therefore, development should be restricted or require geotechnical studies on slopes greater than 20%.

Data Limitations

The data on avalanche and landslide hazards in Park County is quite limited. These hazards are not expected to seriously threaten the community, and therefore, have not been studied thoroughly. The data that does is exist is either on a national, not county-wide, scale or is old and somewhat obsolete. Avalanches and landslides are such site specific events that pinpointing specific vulnerable areas is quite difficult and costly. Therefore, this hazard profile is general in nature and could be more specific if better data is ever compiled. Irregardless, individual property owners are encouraged to consider these hazards specific to their site.

AVIATION ACCIDENT

Description

Aviation accidents can occur for a multitude of reasons from mechanical failure to poor weather conditions to intentional causes. Accidents can vary from small single engine aircraft to large commercial jets. The location of the accident, such as a remote area versus a populated location, also plays an important role in the amount of destruction caused.

Park County has four small airports – Mission Field (LVM), 5 miles east of Livingston, Gardiner Airport (29S), 2 miles northwest of Gardiner, Wilsall Airport (9U1), 4 miles northwest of Wilsall, and Paradise Valley Flying Y Ranch Airport (MT48), 12 miles south of Livingston. Chico Hot Springs formerly used the roadway leading to the resort as a runway but is no longer using it in this capacity. These airports serve non-commercial, private commuter, and recreational aircraft. Mission Field, owned by the City of Livingston and Park County, has one paved runway and two grass runways with a weight limit of 110,000 lbs for a double tandem wheeled aircraft. The airport serves an average of 113 aircraft operations/week. Gardiner Airport has one paved runway with a weight limit of 4,000 lbs, single wheel. This airport conducts an average of 24 aircraft operations/day. Wilsall Airport has one turf runway and averages about 50 aircraft operations/month. The Paradise Valley Flying Y Ranch Airport is a private airport with one turf runway.[14]

Commercial service is provided by a number of area airports including Bozeman/Belgrade, West Yellowstone, Billings, and Helena. Large passenger aircraft serving these airports and passing over the region often fly over Park County. Small aircraft accidents may be relatively minor in nature involving none or few casualties, whereas, a large commercial aircraft could create a mass casualty incident requiring outside assistance.

In addition to established airports and fixed wing traffic, helicopters and other aircraft can be found in most other areas of the county. An active wildfire season increases spotting and suppression activities by air and heliports may be set up in many locations. Other locations, such as Livingston Memorial Hospital, have frequent helicopter traffic conducting medical transports. Several Park County residents also have their own personal aircraft operating to and from their property.

History

Table 4.28 briefly summarizes the accident reports filed by the National Transportation Safety Board as occurring in Park County.

Table 4.28 NTSB Incident Report Summary for Park County, Montana[15]

Date	Casualties	Cause
May 17, 1964	None	Student pilot went nose down during takeoff in windy conditions at Mission Field.
July 25, 1965	None	Aircraft collided with a rock during an off airport landing near Livingston.
August 22, 1965	None	A ground loop occurred during landing at Mission Field due to inadequate maintenance of landing gear.

[14] Statistics provided www.airnav.com
[15] Information derived from the National Transportation Safety Board aviation accident database: http://www.ntsb.gov/

Table 4.28 (continued) NTSB Incident Report Summary for Park County, Montana

Date	Casualties	Cause
June 30, 1966	None	Aircraft was destroyed when it crashed at Mill Creek during a turbulent final approach.
August 10, 1967	None	Student pilot stole the aircraft and crashed near Livingston while attempting to hover.
April 14, 1968	None	Aircraft went nose down during takeoff at Mission Field during windy conditions.
July 1, 1968	None	Plane collided with a fence while trying to take off on a muddy runway at Wilsall Airport.
May 27, 1969	None	A ground loop and landing gear failure occurred during a landing at Mission Field in windy conditions.
August 2, 1969	3 fatal	Aircraft crashed at Mission Field during an emergency landing after complete engine failure while enroute to Rapid City, SD from Butte, MT
October 31, 1970	None	Student pilot collided with a fence at Mission Field while attempting to land.
August 19, 1971	None	A hard landing with landing gear collapse at Mission Field caused substantial damage to the small aircraft.
September 14, 1972	None	An aircraft collided with a fence near Livingston after attempting an emergency landing due to partial power loss in an engine.
March 30, 1974	None	The nose of the small aircraft toppled over after landing in windy conditions at Mission Field.
June 25, 1975	None	An aircraft overturned while taxing after landing in windy conditions at Mission Field.
March 26, 1977	None	Aircraft rolled into a ditch while trying to land on a road near Gardiner after becoming lost.
December 23, 1977	None	Emergency landing near Livingston enroute to Big Timber from Bozeman after the inability to clear a ridge due to downdraft weather conditions and the resulting power failure in the engine.
May 29, 1978	2 fatal	The plane crashed in Pray after flying into a thunderstorm.
June 25, 1979	None	Aircraft landed in a swamp near Emigrant during an emergency landing after engine failure.
March 8, 1982	1 fatal	The accident occurred about six miles west of Livingston near a ridge obscured by clouds. The pilot was not instrument rated.
April 16, 1982	None	Landing gear sank in the mud during landing in Gardiner. Another aircraft was also stuck on the other runway.
May 25, 1984	None	Aircraft was damaged after experiencing extreme turbulence near Crazy Peak while enroute to Lewistown, MT. The plane landed in Lewistown safely but substantially damaged.
October 18, 1984	None	Left side of aircraft struck the ground during takeoff in gusty winds at Mission Field. The pilot did not take off on the preferred runway.
July 29, 1985	1 fatal 1 seriously injured	Plane crashed near Wilsall after flying into poor weather conditions while enroute to Powell, WY from Polson, MT. The pilot was not instrument rated
June 30, 1987	None	During a search and rescue flight near Crazy Mountain, a downdraft caused an engine stall and a collision with trees near the ridge line.
May 6, 1989	2 seriously injured	Aircraft was "buzzing" the tree line near military units conducting training exercises south of Livingston when it crashed.
July 27, 1993	None	Pilot swerved off of runway into a ditch during takeoff in windy conditions at the Flying Y airport.

Table 4.28 (continued) NTSB Incident Report Summary for Park County, Montana

Date	Casualties	Cause
September 15, 1995	None	Equipment malfunction and possible winds caused plane to slide off the runway and collapse landing gear in Pray.
June 27, 1996	2 fatal	Plane crashed while trying to abort a landing in gusty winds at Chico Hot Springs.
July 12, 1998	None	While taking off from the north (non-standard direction) from Chico Hot Springs, the aircraft struck a fence and crashed into the hilly terrain.
November 27, 1998	None	During an elk spotting flight, wind conditions and resulting altitude problems resulted in impacting trees near Jardine, however, the plane was able to return and land in Gardiner.
July 12, 2000	None	Aircraft collided with a fence at Chico Hot Springs while attempting to land in gusty winds.
May 31, 2001	None	Pilot error during takeoff resulted in rotor blades stalling, hitting the ground, and the tail to be cut off at the Gardiner airport.
August 31, 2001	3 fatal	Firefighting helicopter test flight for equipment maintenance in which a bucket line tangled in a rotor causing the aircraft to crash three miles south of Emigrant.

Probability

As the historical record demonstrates, the probability for a private, small aircraft accident is much greater than one involving a large commercial jet in Park County. Although an incident involving a commercial passenger flight and mass casualties cannot be ruled out, the probability is considered low. Statistics complied based on NTSB incident reports can be found in Table 4.29. Table 4.30 shows the number of incidents by 10-year periods.

Table 4.29 Summary by Location of NTSB Reported Accidents for Park County

Location	Number of Incidents	Fatalities
Mission Field	10	3
Gardiner Airport	2	0
Chico Hot Springs/Pray	4	2
Wilsall Airport	1	0
Flying Y Airport	1	0
Off Airport	15	7
TOTAL	**33**	**12**

Table 4.30 Summary by 10-year Periods of NTSB Reported Accidents for Park County

Period	Number of Incidents	Fatalities
1964-1973	12	3
1974-1983	8	3
1984-1993	6	1
1994-2003	7	5
AVERAGE	**8.25**	**3**

Based on these statistics for Park County over a forty year period (1964-2003), a ten-year average can be derived. In an average ten-year period, 8.25 incidents causing damage can be expected involving

three fatalities. Fortunately, the number of incidents appear to be decreasing somewhat, however, the number of fatalities have not.

Mapping

The statistics show that incidents occur both on and off airport facilities. Therefore, determining hazard areas based on airport locations would only be minimally beneficial, would not show all hazard areas, and therefore, will not be completed here.

Associated Hazards and Other Factors

The hazard of aviation accidents can involve multiple factors. The two most significant include the location of the accident and the cargo on board. The location of an aviation accident will determine the significance of ground casualties and damages. An aircraft accident in a populated downtown area has a much greater potential for additional casualties and property damage than one that occurs in a remote part of the county. The location also affects the ability of responders to get to the crash site. The mountainous terrain in Park County can make rescues and recovery difficult, particularly during inclement weather. The cargo is an important factor if such cargo would create a hazardous material release or increased fire hazard. Should the contents of the aircraft be hazardous, the situation would need to be treated not only as an aviation accident but also as a contaminated site. The possibility of an aviation accident as an intentional act cannot be ruled out, in which case, the accident site would also become a crime scene and possibly involve mass casualties.

Any hazard that involves aircraft in the response or recovery could also have an aircraft accident as an associated hazard. The helicopter crash during the Fridley Fire in 2001 is an example. Other possibilities include supply aircraft hauling recovery materials following an earthquake or flood. Wind, a known and common hazard in Park County, has been documented as contributing to many of the aircraft incidents listed in Table 4.28.

Vulnerability

Critical Facilities

All critical facilities in Park County are considered to be at risk from aircraft accidents. Given the nature of historical events and the probability of a specific facility being hit, the overall vulnerability of any given critical facility is considered very low. Livingston Memorial Hospital, however, has been identified as a facility at an increased risk because of the helicopter medical transport operations conducted there. The landing pad for the helicopters is very close to active patient areas of the hospital and the potential for an accident damaging the hospital is somewhat greater. The only infrastructure that can be considered at a slightly higher risk are the tall communications towers and power lines. Again, however, the likelihood of this type of infrastructure coinciding with a crash site is considered low.

Potential Losses

In most aviation accidents in Park County, the losses are limited to the people on board and the aircraft itself. Should an accident occur in a developed area, structural losses in the neighborhood of $200,000 (2 homes x $97,900/average home) plus ground casualties could be found. A large commercial jet in a developed area could potentially destroy an entire city block for a loss of roughly $1,000,000 (assuming 10 or so structures were destroyed). Additional losses, including potential economic losses, could result from the response and recovery efforts during a mass casualty incident of this magnitude.

Potential Population Impacts

The population impacts are going to be directly related to the type of aircraft involved, the number of people on board, the location of the accident, and the number of people in the area of the crash site. Typically, with aircraft accidents, very little warning exists so the population would be unaware until after the event occurred.

Impact of Future Development

Due to the somewhat random location of aircraft accidents, the impact of future development is generally the same irregardless of where that development occurs, with the possible exception of in the immediate vicinity of the airport. Therefore, the impact of future development is considered minimal.

Data Limitations

The National Transportation Safety Board keeps very detailed records of damaging aircraft incidents. These records allow for in-depth analysis of individual accidents. The randomness of aircraft accidents, however, limits the usefulness of such information in determining the potential for losses and areas of greatest hazard. Data outlining the number of aircraft passing over Park County and the areas they typically traverse would help to quantify the potential for additional major accidents.

COMMUNICABLE DISEASE and BIOTERRORISM

Description

Disease can be devastating to a community through its population or its economy. Human diseases when on an epidemic scale can lead to high infection rates in the population. Depending on the disease, quarantines and mass fatalities may result. Highly contagious diseases are the most threatening to the community, and even if the mortality rate is low in the general population, such as with influenza, the disease can be highly hazardous for the elderly, children, and those with suppressed immune systems.

Humans are not the only disease concern. Contagious animal and plant diseases could distress the agricultural community. In such a situation, food supplies and the economy would be threatened, depending on the disease and animal or plant affected. Known livestock and animal diseases such as Foot and Mouth, Chronic Wasting, Bovine Spongiform Encephalopathy (BSE or Mad Cow Disease), West Nile, and Brucellosis, among others, could have damaging effects on the livestock population.[16]

Diseases can be transported in a number of ways including naturally and intentionally. Naturally occurring diseases, some of which may not have even formed yet, could infect the population or agriculture with little notice. Others, such as influenza, may be particularly severe in any given year. Terrorists could use biological agents as a method of attack on both our population and food supplies.

History

Diseases are a part of everyday life. When they significantly impact the population, however, actions are taken to prevent additional infection. Most recently, a statewide measles outbreak in 1988 was noted by the Park County Health Department. Fortunately, very significant events have not occurred in Park County in recent history, but in the early 1900's the Spanish influenza reached epidemic levels. After World War I, the Spanish influenza caused 9.9 deaths per 1,000 people in the State of Montana from 1918-1919.[17]

Probability

The probability of an epidemic in Park County is rather difficult to assess based on history and current data. Medicine has improved significantly over the past 50 years and continues to do so every day. Given the urban nature of Livingston, the probability of rapid infection is somewhat greater than more rural parts of the county and state. The probability of an epidemic infecting humans, animals, or plants is considered moderate.

Given relatively rapid worldwide airline travel and the large influx of tourists to Yellowstone National Park through Park County, a disease originating in another part of the world could easily travel unknowingly to Park County, thus increasing the probability of new diseases in this region as compared to other parts of the state.

[16] Montana Department of Livestock, http://www.discoveringmontana.com/liv/.
[17] Brainerd, Elizabeth and Mark V. Siegler. The Economic Effects of the 1918 Influenza Epidemic. June 2002.

Mapping

The communicable disease and bioterrorism hazard is somewhat uniform across the county. The urban areas may be slightly more vulnerable to the rapid spread of disease in humans, however, the more rural areas are more vulnerable for animal and plant diseases. Therefore, mapping does not enhance this hazard profile.

Associated Hazards and Other Factors

Other disasters such as those that result in the loss or contamination of potable water or sanitary services may result in an increased probability of disease. Often following a large scale disaster, disease is a primary concern. The time of year and weather conditions may also be a factor in the development of an epidemic. A bioterrorism event may be tied to or done in conjunction with a larger scale terrorism event.

Vulnerability

Critical Facilities

Critical facilities are not structurally threatened by communicable disease and bioterrorism, however, their accessibility and function can be lost. Contamination of a critical facility could render the facility non-functional until decontamination or the threat has passed. For this reason, all critical facilities are assumed to be at risk from communicable disease and bioterrorism. As with any human biological event, the hospitals and health service providers would most likely discover a threat and possibly become the first contaminated.

Potential Losses

Potential losses from communicable disease and bioterrorism, in addition to the obvious population impacts (discussed in the next section), is to the economy. Human, animal, or plant diseases may all have a significant impact on the Park County economy, particularly tourism or agriculture. A human quarantine or highly publicized event may affect sales in the community through tourism and resident services, resulting in long term economic impacts. Animal or plant diseases nationwide could have an overarching effect on the national economy. More directly, however, Park County has 527 farms totaling nearly 1,800,000 acres. In 2002, total cash receipts from agriculture were $19,964,000 with $14,084,000 from livestock sales. At the start of 2004, Park County had 42,000 head of cattle, 2,000 sheep, and hundreds of chickens for agriculture purposes.[18] This income and livestock could be lost in a severe animal disease outbreak.

[18] Montana Agricultural Statistics Service, http://www.nass.usda.gov/mt/.

Potential Population Impacts

The entire Park County population of 15,694 is at risk for contracting disease. The urban nature of Livingston makes it more vulnerable to rapidly spreading and highly contagious diseases than more rural parts of the county. The number of fatalities in the county would depend on the mortality rate and the percentage of the population affected. The ability to control the spread of disease will be dependent on the contagiousness of the disease, movement of the population, and the warning time involved.

Impact of Future Development

Future development would not be directly impacted by communicable disease and bioterrorism, but any additional residents would be at risk for disease.

Data Limitations

Disease is a difficult hazard to provide specific vulnerabilities for. For a disease to have a major impact, it first has to enter the community and then spread. That starting point, how the disease progresses, and preventative actions taken will determine the eventual outcome. The data and analysis are limited by these outside factors.

DAM FAILURE

Description

Dams have been placed around Montana for many reasons including recreation, flood control, irrigation, water supply, hydroelectricity, and mining. Dams are built and owned by a variety of entities such as private individuals, businesses, and government. They also come in all shapes and sizes from small earthen dams to large concrete structures. The structural integrity of a dam depends on its design, maintenance, and weather/drainage situation. Problems arise when a dam fails and people and/or property lie in its inundation area. Dams can fail for a variety of reasons including poor maintenance, overwhelming weather and flow conditions, or by an intentional act. Dam failure can be compared to riverine or flash flooding in the area downstream from the dam, and sometimes for long distances from the dam, depending on the amount of water retained and the drainage area. Others may be located in areas that result in little if any damages during a failure.

Hazard ratings are given to dams for emergency management planning purposes. These ratings, high, significant, and low, are based on the potential for loss of life and property damage from the failure of the dam, not the condition or probability of the dam failing. Definitions, as accepted by the Interagency Committee on Dam Safety, are as follows:

> *Low Hazard Potential*
> *Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.*
>
> *Significant Hazard Potential*
> *Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environment damage, disruption of lifeline facilities, or impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.*
>
> *High Hazard Potential*
> *Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.*

Park County has one high hazard dam, four significant hazard dams, and nineteen low hazard dams as shown in Table 4.31.

Table 4.31 Dams in Park County, Montana[19]

Dam Name	River	NID Height (feet)	NID Storage (acre-ft)	Drainage Area (sq. mi)	Year Finished	Hazard	Owner
Cottonwood	Cottonwood Creek	51	3,670	34.00	1953	High	State of Montana
Arthun	Antelope Creek Tributary	23	186		1956	Significant	Len Arthun
Kaiser	Muddy Creek Tributary	20	201		1964	Significant	Park Swandal
Nauharodney	Hammond Creek	25	175		1960	Significant	Crazy Mountain Ranch
O'Halloran (Lower)	Looking Glass Creek	23	149		1960	Significant	Loyce O'Halloran
Anderson	Kavanaugh Creek	30	70	2.23	1959	Low	State of Montana
Banana Peel	Slip and Slide Creek	8	63		1952	Low	Franklin Rigler
Bonhomme	Bull Run Creek	26	65		1954	Low	Pete Bonhomme
Dailey Lake	Diffused Surface Water	10	959		1945	Low	State of Montana
D'Ewart	Canal from Flathead Creek	10	52		1951	Low	D'Ewart Ranch Inc.
John Ragsdale	Offstream	19	100		1980	Low	John Ragsdale
Jordan	Antelope Creek Tributary	38	1,260	3.30	1961	Low	Arthun Bros.
Kelly	Shields River Tributary	15	60		1955	Low	Duane Nollmeyer
Landers #1	Muddy Creek Tributary	15	93		1949	Low	Landers Hereford
Merrell	Tom Miner Creek Tributary	15	275	0.75	1966	Low	James Hubbard
Nollmeyer #1	Elk Creek Tributary	25	86		1975	Low	Nollmeyer Farms
O'Halloran #1 (Upper)	Looking Glass Creek	23	149		1958	Low	Gene Marelius
Pepper	Porcupine Creek	20	82		1954	Low	Freda Largent
Pepper #1	North Fork Lena Creek	30	139		1953	Low	Westling Ranch
Pepper #2	North Fork Lena Creek	30	52		1954	Low	Westling Ranch
Thelma #1	Yellowstone River Tributary	19	106		1962	Low	Thelma Gray
Walton	Porcupine Creek Tributary	27	40	2.03	1957	Low	Walton Estate
Westling	Porcupine Creek Tributary	30	39		1954	Low	Westling Ranch
Yastremski	Diffused Surface Water	10	77		1950	Low	Alan Glen

[19] National Inventory of Dams, http://crunch.tec.army.mil/nid/webpages/nid.cfm.

History

The only known dam break in Park County occurred in June 1950 on Soda Butte Creek near Cooke City. Heavy rain and flash flooding caused a dam failure at the McLaren Mine tailings pond spilling contaminated tailings into the creek flowing into Yellowstone National Park.[20] This dam failure did not result in casualties or property damage but had significant ecological impacts. Remediation work was done by the Environmental Protection Agency and sampling continues.

Probability

The probability of dam failure in Park County is considered low. A fair number of dams do exist in the county, but most are of low hazard. Tailings ponds and high or significant hazard dams are the most probable to cause damages, and none are known to be unstable. The Montana Department of Natural Resources keeps an assessment of dams not meeting safety standards. According to this assessment, the Cottonwood Dam does not comply with spillway standards.[5] Therefore, Park County has the possibility of a significant dam break but the probability is considered low.

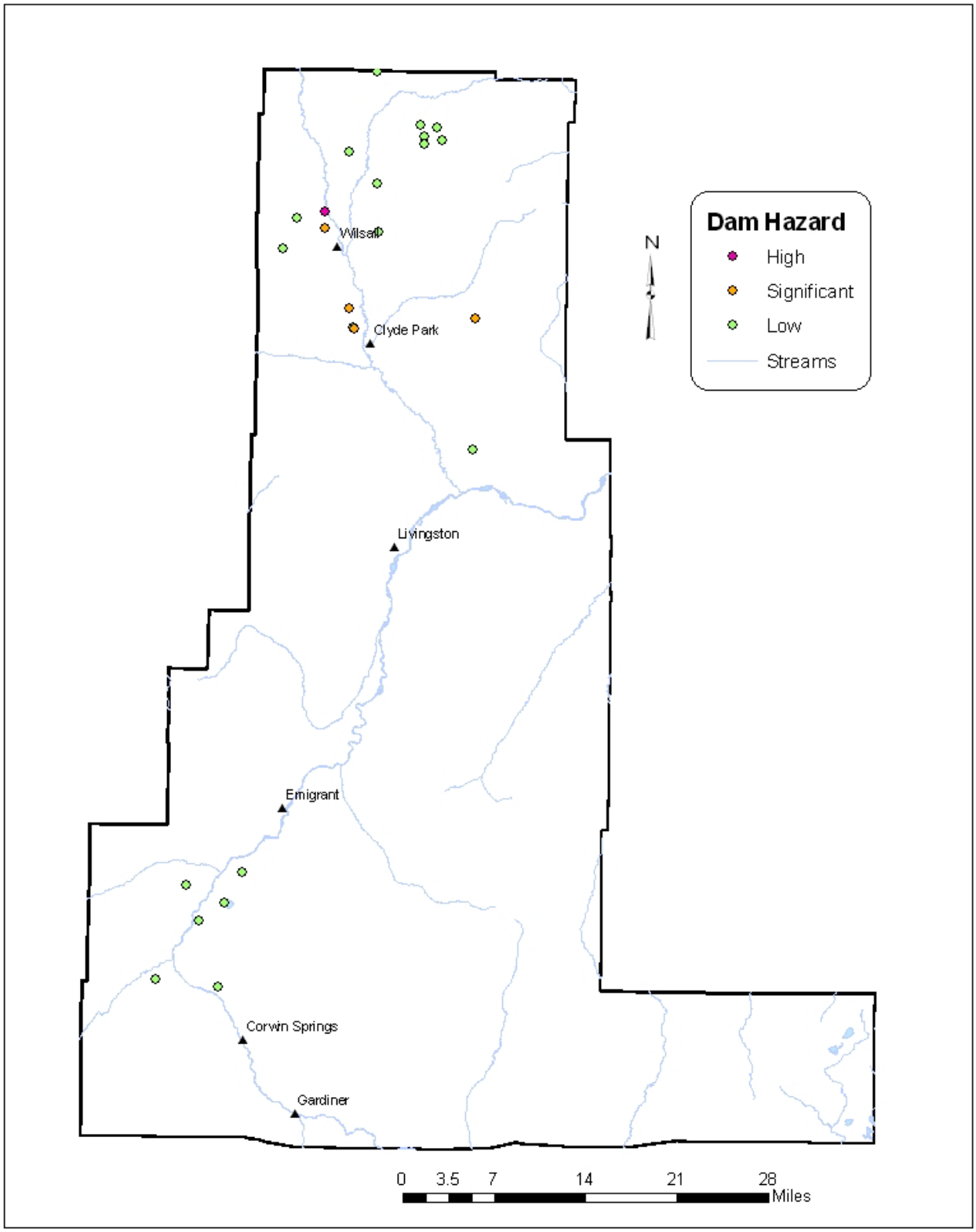
Mapping

The locations and hazard assignment of dams in Park County can be found on Map 4.32. The high and significant hazard dams can be found in the northern half of the county.

Inundation mapping for the Cottonwood and Crazy Mountain Dam (also known as the Nauharodney Dam) exist in their Emergency Action Plans. These maps can be found in the Park County Disaster and Emergency Services office.

[20] US Geological Survey, http://co.water.usgs.gov/toxics/synoptic/soda/#desc.

Map 4.32 Dam Locations and Hazard Ratings in Park County, Montana



Data Source: US Army Corps of Engineers, National Inventory of Dams

Associated Hazards and Other Factors

Dam failure is most often associated with other hazards. Rarely do dams just crumble and break without some other underlying cause. Heavy rainfall or high water levels from rapid snowmelt are typically a contributing factor in a dam failure. In this scenario, flooding may already be occurring, in which case, a dam failure would aggravate the situation. Dams have also broken as a side effect of significant earthquakes. The dams in Park County have not been seismically assessed. Dam failure as a terrorist act has also been proposed by many agencies evaluating our homeland security.

Vulnerability

Critical Facilities

Fortunately, none of the Park County critical facilities are located within the dam failure inundation areas. During a failure, these facilities could be expected to remain functional barring any other conditions. Some roadways may become impassible, making travel to critical facilities more difficult.

Potential Losses

Following a break at the Cottonwood Dam, the flood waters would be in the valley south of Wilsall within a half hour, at the Indian Creek Road Bridge in an hour and a half, at the Highway 89 bridge near Looking Glass Creek in 2.5 hours, near Clyde Park in 3.3 hours, at the Highway 89 bridge over the Shields River near Gibson Ranch in 4.7 hours, and at the Yellowstone River in 8.3 hours.[21] Given the projected inundation area, approximately 25 residences would be affected with a total exposure of roughly $2,642,500. Using an average damage factor of 30%, the losses would total about $792,750 plus damages to roads and bridges.

The Crazy Mountain Dam, also known as the Nauharodney Dam, a significant hazard dam, has an Emergency Action Plan[22] that would be activated should this privately owned dam fail. The inundation area shows potential losses to four structures and roadways. These possible losses include one structure on the dam owner's property, Hammond Creek Road, one house on Cooper Road, one house on Rock Creek Road, one house on Aspen Lane, and Highway 89. Given this scenario, approximately $850,000 in building stock is exposed. Estimating an average damage factor of 30%, the losses would total about $255,000 plus damages to the roadways.

Potential Population Impacts

With any flooding or dam failure event, the loss of life is always possible. As with flash flooding, the warning time for a dam failure can be fairly short, but some warning does exist. The Cottonwood Dam, of all the dams in Park County, poses the greatest risk to lives. With 25 residences in the approximate inundation area, most of those residences could be evacuated if residents were notified in a timely fashion. In the case of the Crazy Mountain Dam, six locations would be evacuated. Given these size evacuations, with some warning time, the potential for the loss of life from dam failure is considered moderate.

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[21] Montana Department of Natural Resources and Conservation, Cottonwood Dam Emergency Action Plan, 2005.
[22] Emergency, Operations, and Maintenance Manual for Crazy Mountain Dam, Crazy Mountain Ranch, January 2002

Impact of Future Development

The areas of Wilsall and Clyde Park near where the high and significant hazard dams are located in northern Park County are currently rural, agricultural areas. Growth can be expected in these areas, particularly closer to Livingston and Interstate 90. Eventually, without consideration of dam failure during the planning process, future development could place residences and business in the hazard areas. Development, in these areas, however, is not expected in the short term.

Data Limitations

Readily available digital data outlining the inundation areas of high hazard dams would allow for a slightly more detailed analysis of potential losses and mapping in this plan. Otherwise, the studies and mapping of the dam hazard are thoroughly outlined in the individual Emergency Action Plans.

To estimate the losses from a dam break, the average damage to the structures and critical facilities impacted was estimated to be 30% since many structures may have little damage while other may be a complete loss. A loss ratio specific to dam failure would allow for a more accurate loss estimation.

DROUGHT

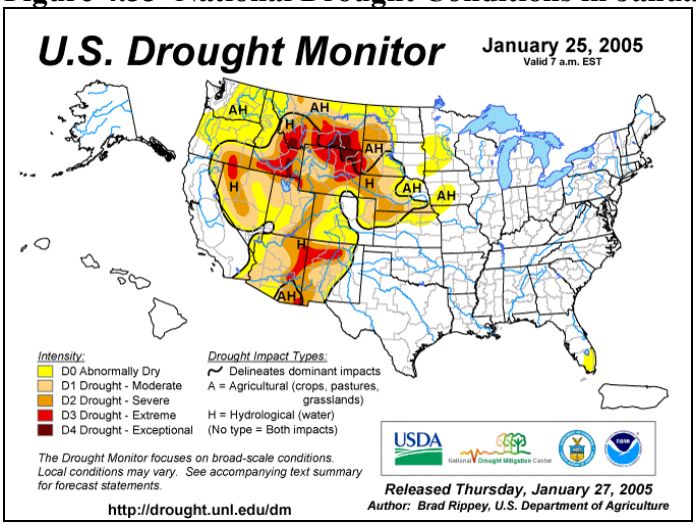
Description

Drought is an insidious hazard of nature. Although it has scores of definitions, it originates from a deficiency of precipitation over an extended period of time, usually a season or more. This deficiency results in a water shortage for some activity, group, or environmental sector. Drought should be considered relative to some long-term average condition of balance between precipitation and evapotranspiration (i.e., evaporation + transpiration) in a particular area, a condition often perceived as "normal". It is also related to the timing (i.e., principal season of occurrence, delays in the start of the rainy season, occurrence of rains in relation to principal crop growth stages) and the effectiveness (i.e., rainfall intensity, number of rainfall events) of the rains. Other climatic factors such as high temperature, high wind, and low relative humidity are often associated with it in many regions of the world and can significantly aggravate its severity.[23]

Droughts can range from minor to severe, short-term to long-term with a variety of determining factors such as precipitation, soil moisture, and tree moisture. A minor, short-term drought can slip by unnoticed while a long-term severe drought can impact the agricultural economy, natural resources such as fish populations, and even public water supplies. In Montana, drought conditions have also been associated with grasshopper infestations and blight.

Montana is known for its arid climate and Park County is no exception. The region has been in drought for the past several years based on climate information, drought indices such as the Palmer Index, and drought monitoring at the national level. Figure 4.33 shows the drought status of the United States in January 2005. Note that Park County is located in the "severe" drought intensity. The State of Montana has a Drought Advisory Committee and a State Drought Plan in place to address this hazard. Historical weather records show that Livingston temperatures can get as high as 105ºF in the summer with extremely low humidities and high winds. Such dry, hot conditions exacerbate drought conditions during periods of low precipitation.

Figure 4.33 National Drought Conditions in January 2005



[23] National Drought Mitigation Center, http://www.drought.unl.edu/index.htm.

History

Drought has a long history in Park County and all of Montana. Paleoclimate studies show extreme periods of drought hundreds of years ago. The periods of 200-370 A.D., 700-850 A.D., and 1000-1200 A.D. are identified as long-term periods of drought in the Northern Great Plains.[5] With the development of a more detailed weather monitoring network, climate records generally date back 100 years in Montana. Based on data from Montana Disaster and Emergency Services, Park County has been in drought several times over the past decade. Table 4.34 identifies and describes these periods.

Table 4.34 Park County Drought Periods since 1900[9]

Time Period	Description
1930's	The "Dust Bowl" created erosion problems and dust storms throughout the state.
Mid 1950's	Extended period of reduced rainfall in Eastern and Central Montana.
1960's (1961 and 1966 specifically)	Entire state affected, although the impact of this drought was lessened through better conservation practices such as strip cropping.
1970's	By May 1977, over 250,000 acres of Montana farmland was damaged by wind. The State of Montana began taking protective measures due to critically low hydroelectric power supplies.
1985	USDA drought disaster declaration. A typical 2,500 acre farm lost more than $100,000 in equity. The state agriculture industry lost nearly $3 billion in equity.
July 25, 1988	Park County Resolution #270 declares a disaster from drought. Within the county, 526 farmers sustained crop losses, with 350 of those farms sustaining losses 50% or greater and 126 sustaining losses of 20-49%.
2000-2005	Statewide drought disaster designations in 2000, 2001, and 2002. In 2004, Park County was given a USDA Secretarial Disaster Designation. Most protective measures were conducted at the county level.

Probability

The National Oceanic and Atmospheric Administration Paleoclimatology Program studies drought by analyzing records from tree rings, lake and dune sediments, archaeological remains, historical documents, and other environmental indicators to obtain a broader picture of the frequency of droughts in the United States. According to their research, "…paleoclimatic data suggest that droughts as severe as the 1950's drought have occurred in central North America several times a century over the past 300-400 years, and thus we should expect (and plan for) similar droughts in the future. The paleoclimatic record also indicates that droughts of a much greater duration than any in the 20th century have occurred in parts of North America as recently as 500 years ago."[24] Based on this research, the 1950's drought situation could be expected approximately once every 50 years or a 20%

[24] National Climatic Data Center, Paleoclimatology Branch, http://www.ngdc.noaa.gov/paleo/paleo.html.

chance every ten years. An extreme drought, worse than the 1930's "Dust Bowl," has an approximate probability of occurring once every 500 years or a 2% chance of occurring each decade.

Mapping

Drought is regional hazard, and therefore, mapping at the county level is not appropriate here. The county is assumed to have the same risk countywide. Mapping of the current drought status is published by the US Drought Monitor weekly and the Montana Drought Advisory Committee monthly from March through October.

Associated Hazards and Other Factors

Drought is most commonly associated with wildfire in Park County. Dry conditions contribute to lower moisture content in the trees and plants that provide fuel for wildfires. An initial look at the driest years show that they do not directly coincide with severe wildfire seasons, however, the effects of drought can carry into the long term. One season of severely low precipitation may not be enough for extreme fire behavior, however, followed by several seasons of below normal precipitation, the conditions can contribute to an increased probability for significant wildfires. Drought often kills trees and plants that then become very dry fuels for wildfires years later. Short-term drought conditions can prime grasses on non-irrigated lands for grass fires and long-term drought conditions can additionally impact the heavier timber fuels for forest fires.

Counter intuitively, in mountainous areas, such as those found in Park County, drought can quickly be followed by flash flooding. Dry soils are not as permeable to water, particularly if the vegetation has been killed, and therefore, heavy rains run off faster than on moist soils with green vegetation and can more easily lead to flash flooding.

Blight and grasshopper infestations have a greater probability of occurring in drought conditions. Besides the hydrologic and agricultural impacts, drought can also lead to severe dust storms and soil erosion affecting the population and non-agriculture economies. Additional concerns include the water temperatures for fish populations, wildlife health, changes in plant ecology, hydroelectric power supplies, and public water sources.

Vulnerability

Critical Facilities

Generally, critical facilities are not affected directly by drought. Infrastructure relying on the water supply is the primary exception. If the water supply for public drinking water and sewer systems was threatened, those losses could total millions of dollars should equipment be damaged or outside water need to be shipped into the county. The probability of a drought of that significance is considered low.

Potential Losses

The most probable losses from drought are to the economy. Drought significantly impacts the agricultural economy and can additionally impact tourism. Park County totaled over $5,880,000 in

crop sales during 2002. Crops are very directly affected by drought and this economy could potentially be lost if drought conditions persist for a period of time.

Crops aren't the only aspect of agriculture affected by drought. Livestock can also be impacted. The pasture and food supply available to the animals is directly related to drought conditions. With over $14,000,000 in livestock sales in 2002, this larger agriculture economy is additionally threatened by drought.

Natural resources, and therefore tourism, are influenced by drought. As river and stream levels drop, fish populations and other natural resources are impacted. With fishing and river recreational activities a very important part of the tourism industry in Park County, those aspects of the economy can be threatened during extended periods of drought.

Potential Population Impacts

Since drought evolves slowly over time, the population has ample time to prepare for its effects and is warned accordingly. The greatest direct threat to the population from drought is through the drinking water supply. Should a drought affect the water available for public water systems or individual wells, the availability of clean drinking water could be compromised. This situation would require emergency actions and could possibly overwhelm the local government and financial resources.

Impact of Future Development

Future development's greatest impact on the drought hazard would be through possibly limiting ground water resources. Fortunately, public systems, individual wells, and septic systems are carefully monitored and regulated by Montana Department of Environmental Quality. Therefore, the impact of future development with respect to drought is considered low.

Data Limitations

The greatest data limitation with drought is the inability to pinpoint the start and end of drought periods and the associated correlation with economic losses. An online database of historical USDA drought declarations and the associated losses would prove beneficial in documenting the effects of drought and directing mitigation activities.

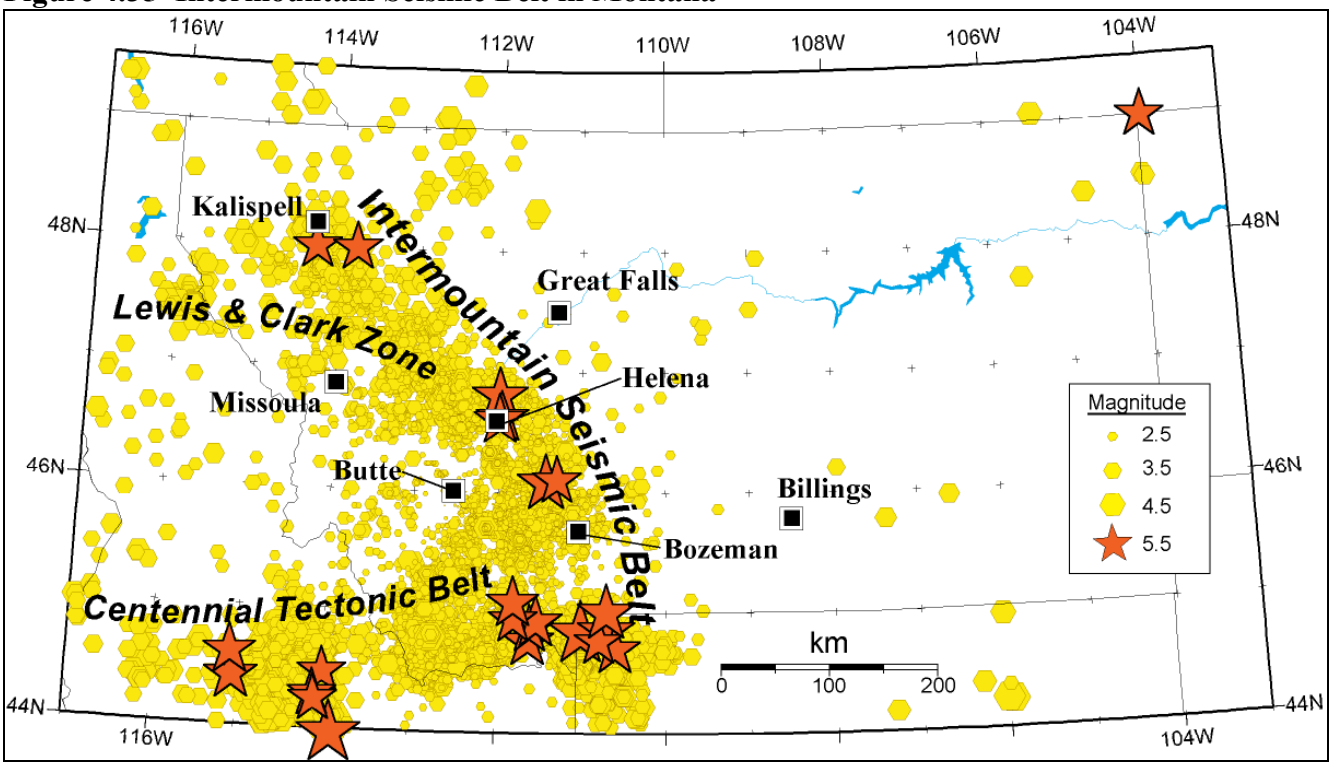
EARTHQUAKE

Description

One of the most frightening and destructive phenomena of nature is a severe earthquake and its terrible aftereffects. An earthquake is a sudden movement of the Earth, caused by the abrupt release of strain that has accumulated over a long time. For hundreds of millions of years, the forces of plate tectonics have shaped the Earth as the huge plates that form the Earth's surface slowly move over, under, and past each other. Sometimes the movement is gradual. At other times, the plates are locked together, unable to release the accumulating energy. When the accumulated energy grows strong enough, the plates break free. If the earthquake occurs in a populated area, it may cause many deaths and injuries and extensive property damage.[25]

Montana is the fourth ranked state in the United States for seismicity and has many faults, primarily in the mountainous parts of the state. Yellowstone National Park, within and to the south of Park County, is an active geothermal area with approximately earthquakes 2,000 each year. The Intermountain Seismic Belt, shown in Figure 4.35, demonstrates the active seismic areas of the state. Park County lies just to the east and north of the most active areas and has been in close proximity to many significant earthquakes. Earthquakes can damage property and infrastructure very rapidly and significantly with little warning, severely impacting those close to the epicenter and being felt for hundreds of miles.

Figure 4.35 Intermountain Seismic Belt in Montana[26]



[25] US Geological Survey, http://pubs.usgs.gov/gip/earthq1/intro.html.
[26] Montana Bureau of Mines and Geology, Earthquake Studies Office, http://mbmgquake.mtech.edu/interm_s_b.html.

History

Since 1900, sixteen earthquakes of magnitude 5.5 or greater have occurred within 100 miles of Park County. Table 4.36 shows the list of these earthquakes.

Table 4.36 Earthquakes Magnitude 5.5 or greater within 100 miles of Park County, Montana[27]

Date	Approximate Location	Magnitude
6/28/1925	Clarkston	6.6
2/16/1929	Lombard	5.6
10/12/1935	Helena	5.9
10/19/1935	Helena	6.3
10/31/1935	Helena	6.0
11/23/1947	Virginia City	6.1
8/18/1959	Hebgen Lake	7.5
8/18/1959	Hebgen Lake	6.5
8/18/1959	Hebgen Lake	6.0
8/18/1959	Hebgen Lake	5.6
8/18/1959	Hebgen Lake	6.3
8/19/1959	Hebgen Lake	6.0
10/21/1964	Hebgen Lake	5.6
6/30/1975	Yellowstone Park	5.9
12/8/1976	Yellowstone Park	5.5
7/25/2005	Dillon	5.6

The closest of these earthquakes to southern Park County were the Hebgen Lake and Yellowstone Park earthquakes, and to northern Park County, the Clarkston and Lombard earthquakes.

The Clarkston earthquake, in neighboring Gallatin County, caused relatively light damages due to the rural nature of the area at that time. Most of the damages were confined to Manhattan, Logan, Three Forks, and Lombard in Gallatin and Broadwater Counties. The earthquake was felt from the North Dakota line to Washington and from the Canadian border to central Wyoming, including Park County. Unreinforced brick structures suffered the greatest damages. Livingston felt five distinct shocks. Pavement and buildings sustained cracks up to an inch wide. Mines in Jardine were feared to have been damaged. Livingston police reported the tower of a high building swaying with many people fainting and rushing to the streets. A train from Livingston was sent to rescue passengers from trains trapped by landslides near Lombard. In Clyde Park, the stock of tinware at Jack O'Leary's store fell off the shelves.[28]

The 1935 earthquakes in Helena triggered a landslide 24 miles south of Livingston on the east side of the Yellowstone River. Telephone wires and the roadway were buried. The roadway was cleared by the next day.[12] The Wilsall School also sustained considerable damages from this series of

[27] Stickney, Michael et al. Quaternary Faults and Seismicity in Western Montana. Montana Bureau of Mines and Geology Special Publication 114, 2000.
[28] University of Utah, http://www.seis.utah.edu/lqthreat/nehrp_htm/1925clar/n1925cl1.shtml#misbes.

earthquakes. The 1947 Virginia City earthquake caused "very light" shaking in Livingston.[29] The 2005 Dillon earthquake was felt throughout Park County, but no damages were reported.[30]

The initial Hebgen Lake earthquake on August 18, 1959 is the most significant earthquake to have occurred in the region over the past 100 years. This magnitude 7.5 earthquake occurred about 30 miles from Gardiner and about 70 miles from Livingston. This surface rupturing earthquake changed the geology of the Hebgen Lake area and triggered a major landslide (80 million tons of rock). The result was the creation of a new lake, Earthquake Lake, on the Madison River and State Highway 287 was buried. Twenty-eight people were killed and roadway and timber damages totaled over $11 million. The quake was felt in 8 states and 3 Canadian provinces.[31] The North Entrance to Yellowstone National Park did have some landslides blocking roadways, but all were cleared within 2 days. Also damaged was the Golden Gate just above Mammoth Hot Springs near Park County. Damages in the Park were estimated at about $2 million. Despite the close proximity of this major earthquake, the damages were not significant in Park County.

Probability

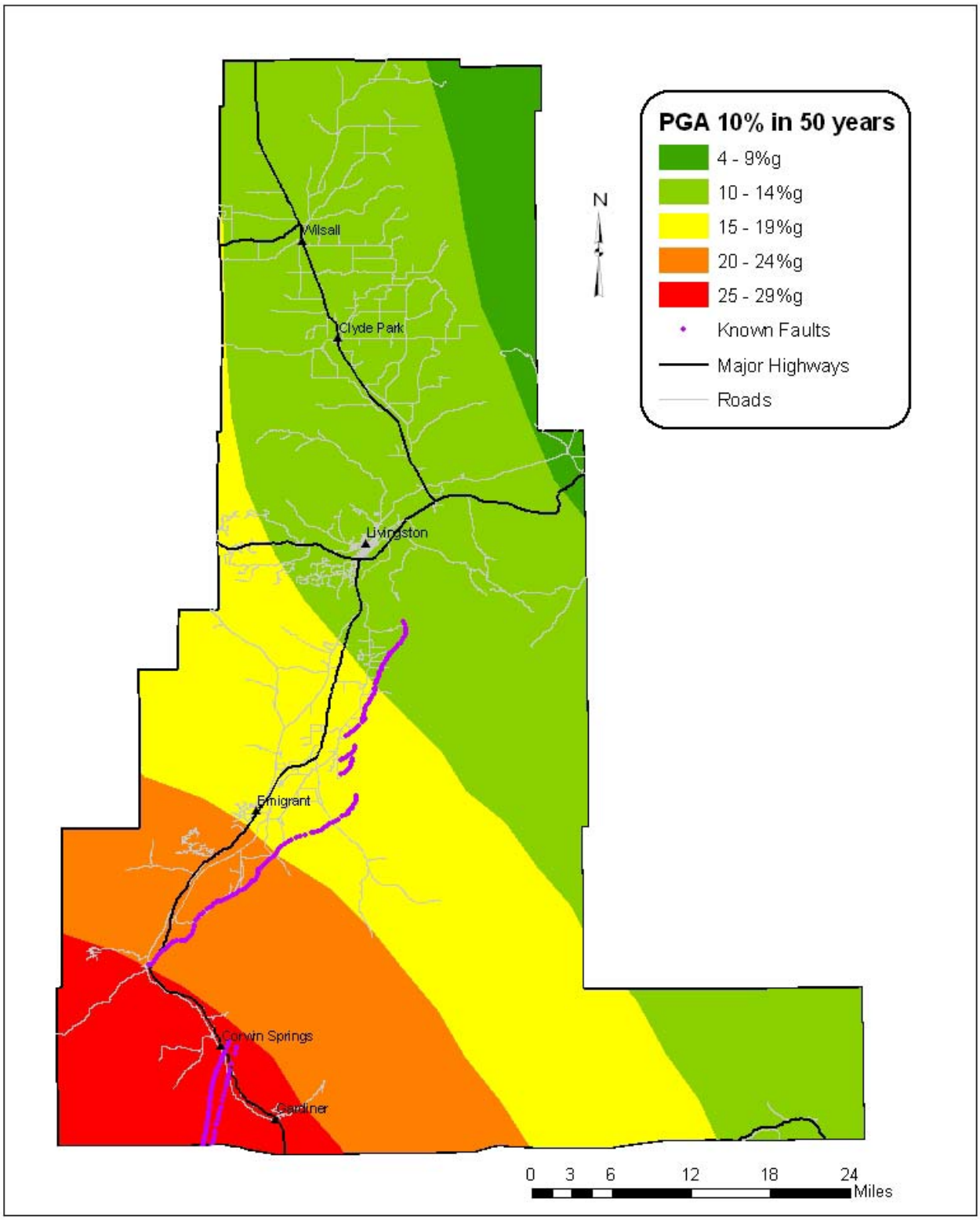
Earthquakes when large and damaging are infrequent events. Park County experiences many small earthquakes every month, but they are undetectable except by instrumentation. The mapping section that follows outlines some of the probabilities used in earthquake modeling as it varies throughout the county. Depending on the earthquake magnitude, recurrence intervals for Western Montana, including Park County, are currently being developed. The geography of Park County is such that it lies within several categories of seismic source zones. The most active of which is the Northern Intermountain Seismic Belt to the north and west. This region is estimated to recurrence rate of 3.84 years for a magnitude 5 or greater earthquake, 22.6 years for a magnitude 6 or greater earthquake, and 133 years for a magnitude 7 or greater earthquake.[5]

Mapping

Research through the US Geological Survey's National Seismic Hazard Mapping Project has resulted in peak ground acceleration maps related to the probability of seismic shaking. The map for Park County, Map 4.37, shows the strength of seismic shaking that has a 10% probability of being exceeded in a 50 year period. The strength of the shaking is measured as a percentage of the acceleration of gravity (%g). Generally, a PGA of 20%g would result in major damage and a PGA of 10%g would result in slight damage. As Map 4.37 shows, the earthquake hazard in Park County is greater to the south and west and less to the north and east. The unincorporated communities of Gardiner and Corwin Springs are at greatest risk.

[29] Daily Missoulian, November 24, 1947.
[30] US Geological Survey, Earthquake Hazards Program, http://pasadena.wr.usgs.gov/shake/imw/.
[31] US Geological Survey, http://neic.usgs.gov/neis/states/montana/montana_history.html.

Map 4.37 Peak Ground Acceleration (%g) with a 10% Probability of Exceedance in 50 Years



Data Source: US Geological Survey and Montana Bureau of Mines and Geology

Table 4.38 and Map 4.37 show potentially active faults within Park County as published by the Montana Bureau of Mines and Geology.[27]

Table 4.38 Known Faults within Park County, Montana[32]

Fault Name	Recurrence Interval	Slip Rate	Length
Emigrant Fault			
Unnamed (north) section	15 ± 10 k.y.	Probably 0.2-1.0 mm/year	8.0 miles (12.9 km)
Unnamed (south) section	15 ± 10 k.y.	0.2-1.0 mm/year	24.9 miles (40.0 km)
East Gallatin Reese Creek Fault			
Reese Creek section	Unknown	Probably <0.2 mm/year	8.4 miles (13.5 km)
Gardiner Fault	N/A	N/A	N/A
Mammoth Fault	N/A	N/A	N/A
Mol Heron Creek Fault	N/A	N/A	N/A

History has shown that significant earthquakes (up to magnitude 6.5) may occur anywhere throughout the Intermountain Seismic Belt, even in areas where young faults are not recognized. Examples of damaging earthquakes for which no known surface fault was recognized include the 1925 Clarkston earthquake (magnitude 6.6) and the 1935 Helena earthquakes (magnitude 6.3-5.9).

Associated Hazards and Other Factors

The seismic action of earthquakes often triggers other events. Landslides are quite common in Montana with large earthquakes. During the winter, avalanches can also be triggered. Dam breaks and landslides on waterways may cause flooding. The rupture of gas lines can result in large scale urban fires, particularly if power outages or broken water mains disrupt water supplies. Any number of additional incidents may occur due to the failure of infrastructure such as hazardous material spills and large scale transportation accidents. All of these associated factors contribute to the severity of the earthquake event.

Vulnerability

Critical Facilities

Since the probability and likely strength of an earthquake varies across the county, the threat to critical facilities can be assessed based on their geographic locations. Structural assessments of the individual facilities would further determine the seismic stability of that structure. Based on geography, however, the critical facilities and vulnerable populations in and around Gardiner can be considered the most vulnerable. The critical facilities north on Highway 89 to Emigrant are the next most vulnerable, followed by those north of Emigrant on Highway 89, and then those in the Livingston, Cooke City, Clyde Park and Wilsall areas. All critical facilities are at risk from earthquakes in Park County, but those to the southwest can be considered the most vulnerable. In addition, unreinforced masonry construction is particularly vulnerable to seismic shaking. Therefore, any critical facilities with, or within close proximity to, unreinforced masonry can be considered at greatest risk.

[32] Haller, Kathleen M., et al. Data for Quaternary Faults in Western Montana.

The State Hazard Assessment values the state-owned building stock in Park County at $2,063,368 with contents valued at $847,125. Using the Annualized Loss Ratio of 0.0106 from FEMA's HAZUS-MH model, the total annualized losses to state buildings in Park County are estimated at $30,851 annually or $1,542,561 every 50 years.[5]

Potential Losses

Earthquake damages can be difficult to predict and assess without detailed structure information or a damage model. Fortunately, the Federal Emergency Management Agency has developed loss estimate software for earthquakes (HAZUS). This model uses national databases to estimate the earthquake losses from a particular event at the census block, tract, or county level. Although the default data provided with the model is far from accurate, the model provides a general estimate of what earthquake losses may occur and the magnitude of such. Should Park County decide to import more accurate data, the results will be significantly improved. The results from a default, level 1 run through the model follows.

HAZUS has an inventory of 7,157 structures and may slightly overestimate the structure replacement values for this area. The infrastructure, including highways, bridges, railways, airports, potable water wastewater, and natural gas systems, was estimated to have a value of nearly $2 billion. Despite some of the inconsistencies of using national datasets, two simulations were run through the model for 100-year and 500-year events.

<u>100-year Earthquake in Park County (Magnitude 5.5)</u>

- Structure Damages:
  - Complete: 1 structure
  - Extensive: 24 structures
  - Moderate: 219 structures
  - Slight: 803 structures
- Losses from capital stock (structural, non-structural, contents, and inventory) and income (relocation, capital related, wages, and rental income): $10,440,000
- Essential facilities remained functional
- Transportation Infrastructure Damages: $1,800,000
- Utility Infrastructure Damages: $5,610,000
- Casualties: 3

<u>500-year Earthquake in Park County (Magnitude 7.5)</u>

- Structure Damages:
  - Complete: 21 structures
  - Extensive: 182 structures
  - Moderate: 823 structures
  - Slight: 2,090 structures
- Losses from capital stock (structural, non-structural, contents, and inventory) and income (relocation, capital related, wages, and rental income): $52,090,000
- Essential facilities remained functional
- Transportation Infrastructure Damages: $5,900,000
- Utility Infrastructure Damages: $24,590,000
- Casualties: 19

These results from HAZUS could potentially be more accurate and informative if better data was developed and used in the analysis. Many structures, including critical facilities, within Park County have not been seismically assessed. As the 2000 US Census data indicates, over 69% of residences were constructed prior to 1980 and over 28% of residences were constructed prior to 1940. Depending on the construction, those homes, businesses, and critical facilities may not be structured to withstand seismic shaking. Downtown Livingston also has a number of unreinforced masonry buildings that house businesses.

Potential Population Impacts

The population would have little or mostly likely no warning prior to an earthquake. Most casualties in a large earthquake in Park County would be anticipated with building collapse, roadway failures, falling objects, and landslides. As the HAZUS runs show, approximately 19 casualties could be expected in a 500 year period. The number of actual casualties will be dependent on a variety of factors including proximity to the epicenter, time of day, and magnitude, among others.

Impact of Future Development

Any future development in Park County is at risk for earthquake damages. Fortunately, construction standards for seismic stability have improved over the past 100 years. Livingston is the only jurisdiction within Park County that has a building code and inspection program. Other areas of the county are under the state building code that for most single family homes is only subject to electrical, plumbing, and septic inspections. Much of the new Paradise Valley construction is taking place in the areas near the identified and active Emigrant Fault. Should an earthquake occur on that fault, the future development that occurs will be in the highest hazard area.

Data Limitations

Since earthquakes are a relatively rare event, perhaps the greatest challenge is understanding the true probability and damages possible. More research is needed in identifying fault areas and developing digital data for use in the HAZUS modules. Improving the modeling and assessing individual facilities will allow for a more accurate vulnerability assessment.

FLOODING

Description

Flooding is the inundation of a normally dry area with water. Floods can be along rivers and streams, in poor drainage areas, or in oversaturated soils. Riverine flooding occurs on rivers, creeks, and streams as water levels rise, be it from excessive precipitation, rapid snowmelt, dam failure, or ice jams. Unlike riverine flooding, flash flooding can happen anywhere. As the name implies, flash flooding happens quickly after intense rains, dam or ice jam breaks, or rapid runoff in mountainous or burnt areas. Urban flooding is the result of development and the ground's decreased ability to absorb the rainfall without adequate drainage systems in place. Flooding from groundwater does not typically result in floodwaters at the surface, but occasionally basements and crawlspaces can be flooded by excessive groundwater.

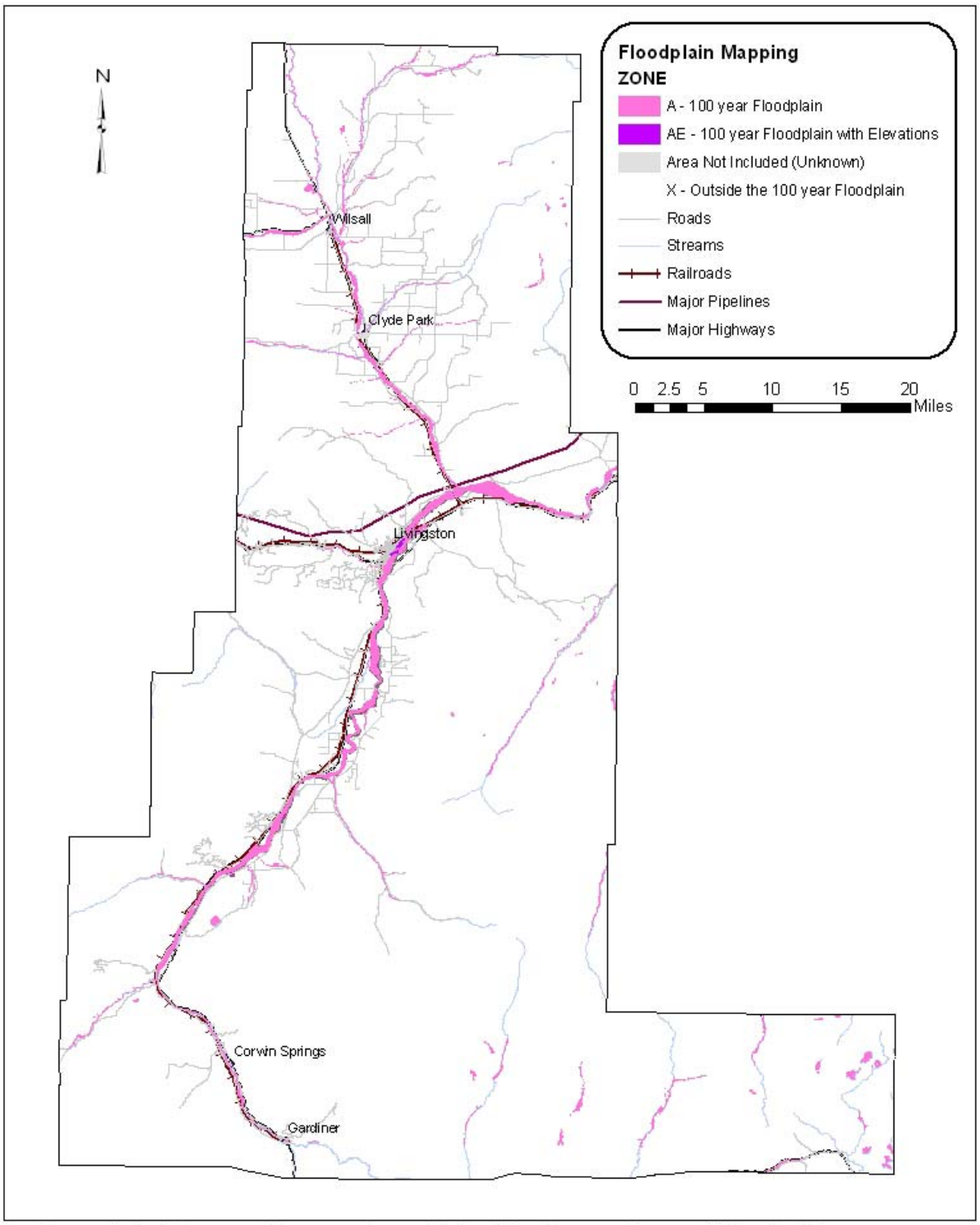
Flooding is different from most other hazards in that it is part of a national insurance system called the National Flood Insurance Program (NFIP) under the Federal Emergency Management Agency (FEMA). FEMA conducts a Flood Insurance Study (FIS) of a region to identify the community's risk levels. The FIS includes statistical data for river flow, rainfall, topographic surveys, as well as hydrologic and hydraulic analyses. After examining the FIS data, FEMA creates Flood Insurance Rate Maps (FIRMs) delineating the different areas of flood risk. Land areas that are at high risk for flooding are called Special Flood Hazard Areas (SFHAs), or floodplains.[33] These maps are certainly not all inclusive and other flood prone areas may exist. In fact, as of March 2005, Park County was undergoing the process of developing new mapping for the Yellowstone River.

The Flood Insurance Study and maps for Livingston were last issued on May 19, 1987. The floodplain mapping for the unincorporated areas of Park County are dated January 1, 1987. Clyde Park is not known to have a serious flood hazard, and therefore, mapping does not exist for that community. A digital, inexact version of the current floodplain mapping termed Q3 data, depicts the SFHAs, and can be found in Map 4.39. Two 100-year floodplain areas are depicted on the maps. Zone A indicates 100-year floodplain areas without elevation data and Zone AE indicates 100-year floodplain areas with elevation data. Zone X areas lie outside the 100-year floodplain. A 100-year floodplain has a 1% chance of being exceeded in any given year. Development in the 100-year floodplain must meet floodplain construction requirements adopted by Park County or the City of Livingston and most borrowers must purchase flood insurance.

Flooding in Park County normally occurs during periods of rapid snowmelt almost exclusively during the months of May and June. The mountainous areas in the upper reaches of the Yellowstone River and Fleshman Creek watersheds keep the snowpack into the early summer months, and as temperatures warm, the mountain snowpack melts rapidly. According to the Park County Flood Mitigation Plan, Park County also has many creeks and streams that are not mapped for flood hazards. The identified, unmapped creeks include Six Mile Creek, Mill Creek (upper reaches), Suce Creek, Cinnabar Creek, Fleshman Creek (upper reaches), Flathead Creek, Bear Creek, Eight Mile Creek, Rock Creek, Tom Miner Creek, Deep Creek, Billman Creek (upper reaches), and Daisy Dam Creek.[34]

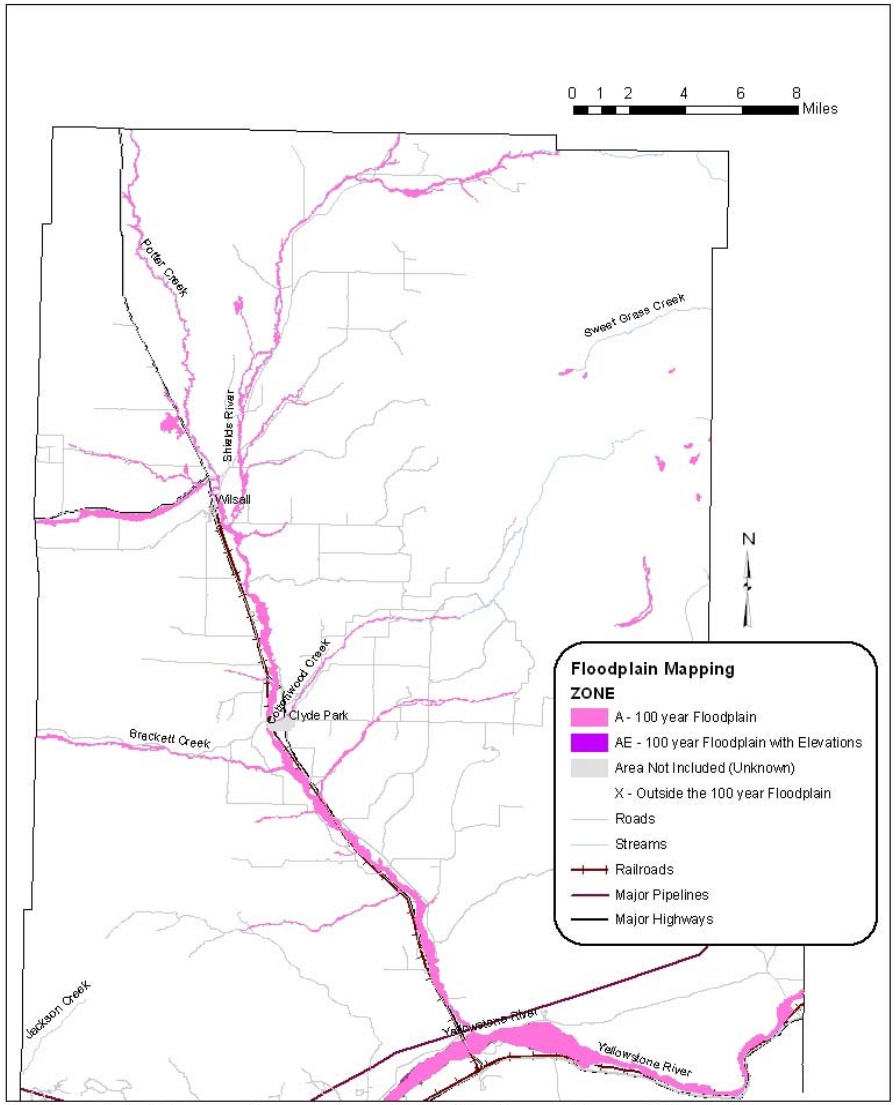
[33] Federal Emergency Management Agency, National Flood Insurance Program, www.floodsmart.gov.
[34] Park County Flood Mitigation Plan, March 3, 1999.

Map 4.39 Park County 100-Year Floodplain



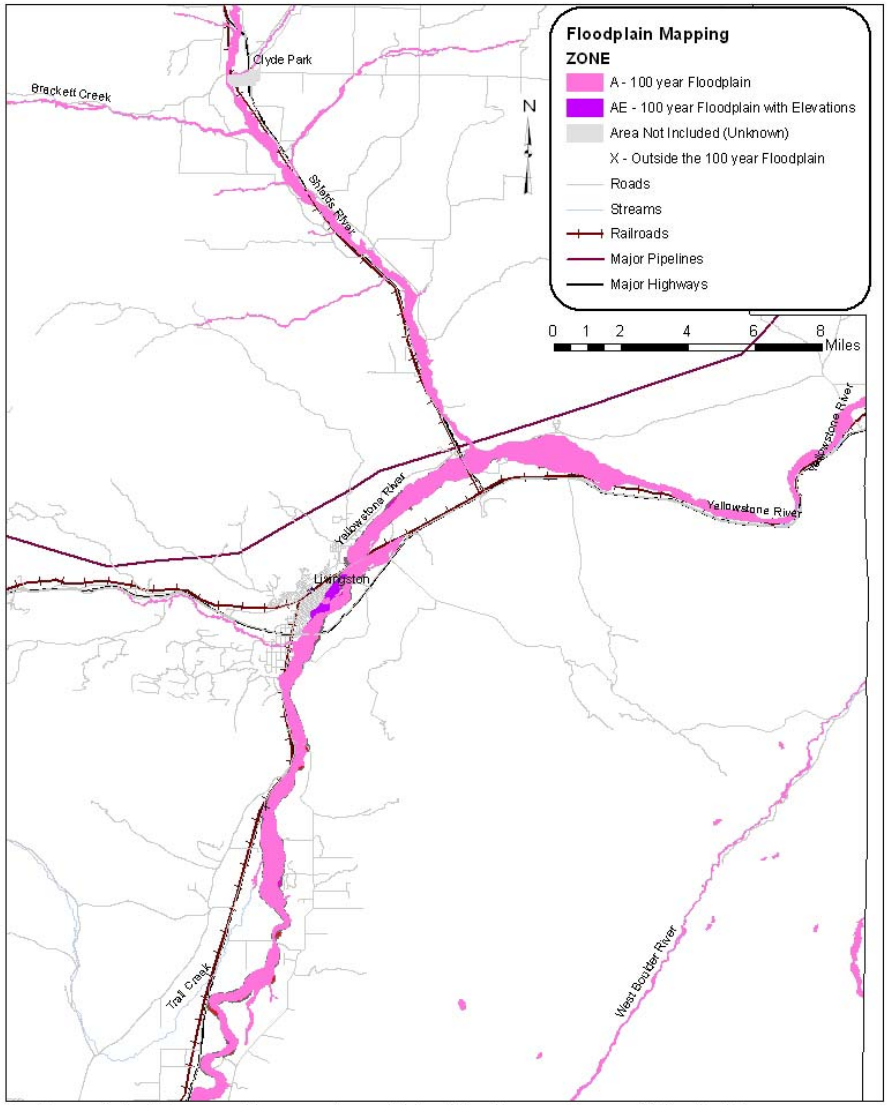
Data Source: Federal Emergency Management Agency, National Flood Insurance Program, Q3 Floodplain Data

Map 4.40 Northern Park County Floodplain



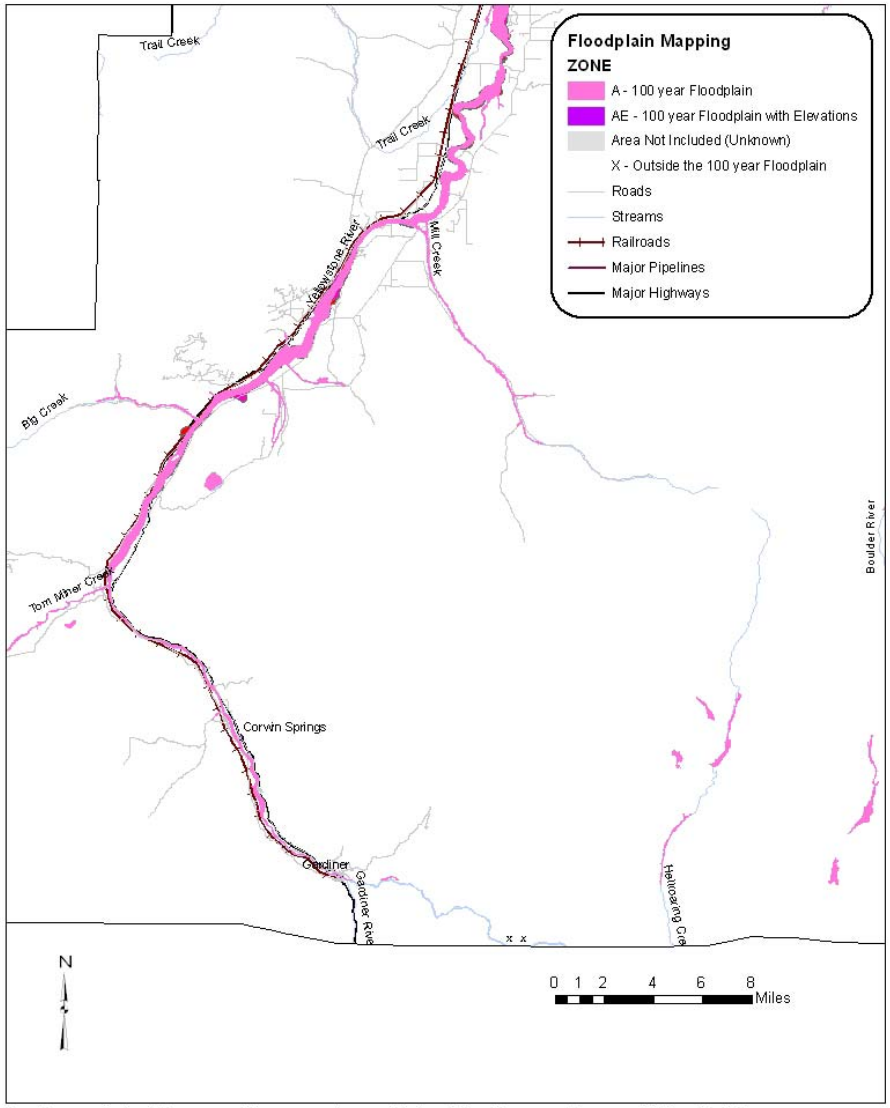
Data Source: Federal Emergency Management Agency, National Flood Insurance Program, Q3 Floodplain Data

Map 4.41 Central Park County Floodplain



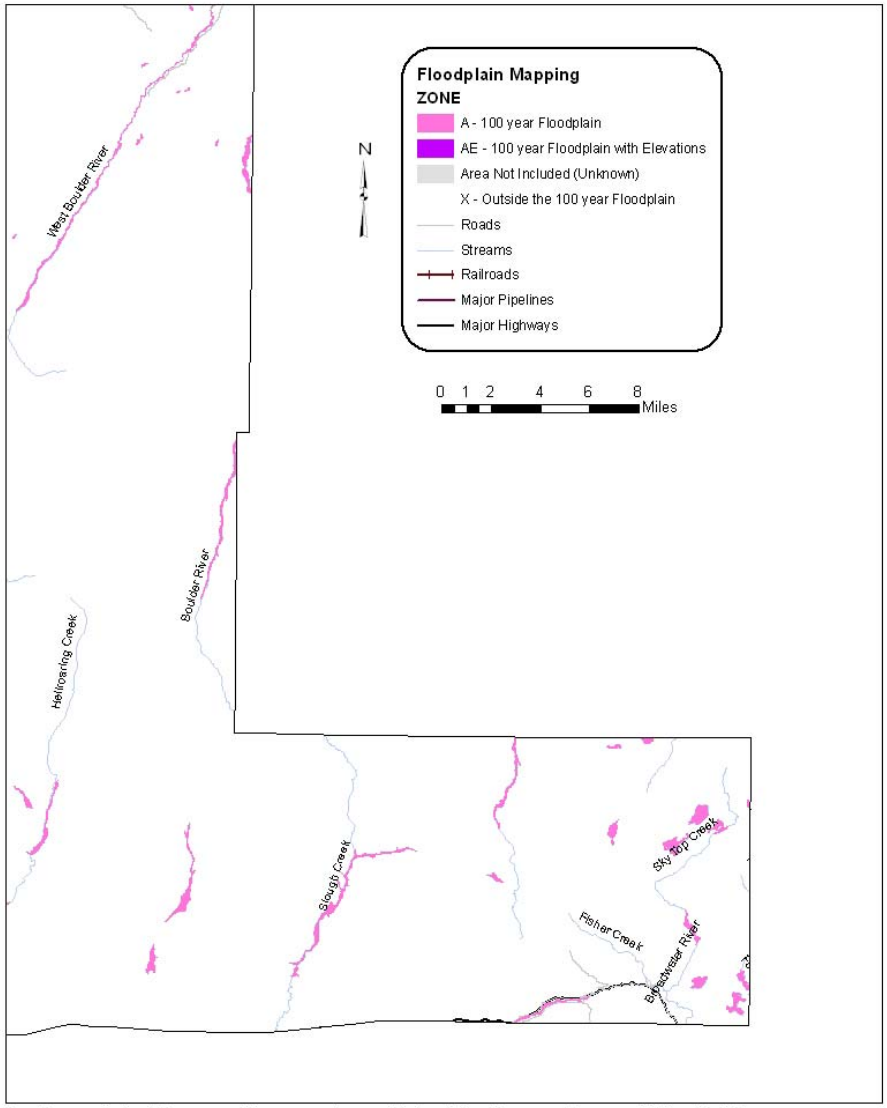
Data Source: Federal Emergency Management Agency, National Flood Insurance Program, Q3 Floodplain Data

Map 4.42 Southern Park County Floodplain



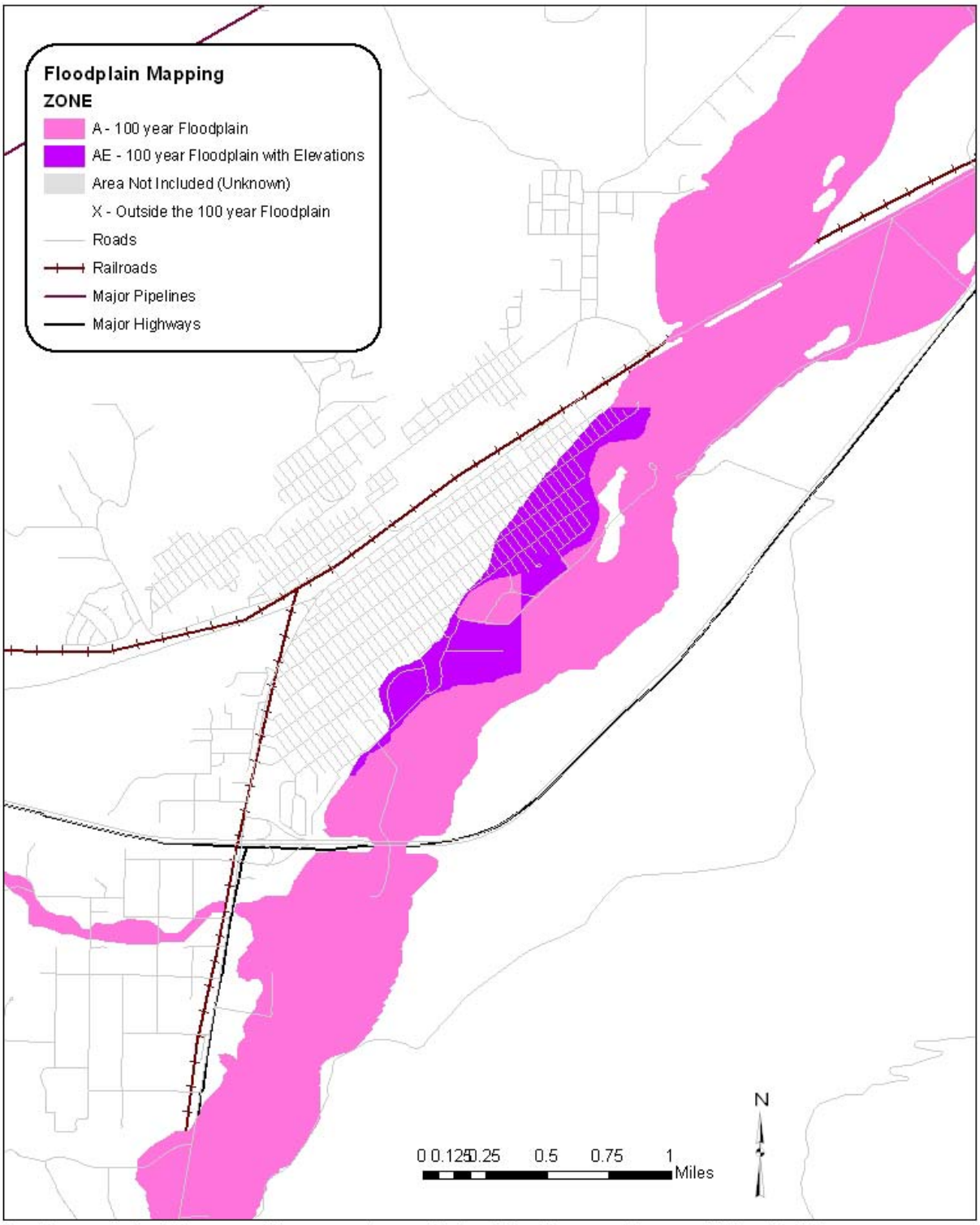
Data Source: Federal Emergency Management Agency, National Flood Insurance Program, Q3 Floodplain Data

Map 4.43 Cooke City/Silver Gate Area Floodplain



Data Source: Federal Emergency Management Agency, National Flood Insurance Program, Q3 Floodplain Data

Map 4.44 Livingston Floodplain



Data Source: Federal Emergency Management Agency, National Flood Insurance Program, Q3 Floodplain Data

Flooding and mitigation on the Yellowstone River in Park County has been such an important community issue that based on a request from the citizens of Park County, Governor Marc Racicot established an Upper Yellowstone River Task Force in November 1997. The purpose of the task force was "to provide a forum for the discussion of issues that effect the Upper Yellowstone River Basin, particularly, to bring together landowners, sportsmen and sportswomen, and community leaders to develop a shared understanding of the issues and competing values and uses that impact the upper Yellowstone River."[35] This task force developed 43 consensus-based river management recommendations and presented them to Governor Judy Martz on October 20, 2003. Many of their recommendations can be found in the mitigation strategy of this plan.

History

Park County has an extensive history of riverine flooding. The first major documented flood occurred in June 1894 with the most recent one in June 1997. The historical record has been complied from the Livingston Flood Insurance Study[36], notes in a Park County Disaster and Emergency Services notebook, and the Park County Flood Mitigation Plan. The damages listed are assumed to be losses paid out by the government due to infrastructure damages, not including private losses. The data sources did not specify how the losses were calculated.

June 4, 1894. Rapidly melting snows supplemented by rainfall caused the Yellowstone River to flow from its banks. The flood crest reached Livingston on June 4 and floodwaters did not begin to recede until June 8. Ninth Street Island, which was uninhabited at the time, was inundated. Livingston Island was flooded to a depth of 3 feet. Thirty-two homes in Riverside Addition were flooded on the first floor, and many city streets were damaged. Damages were estimated at $11,300 in 1894 dollars ($232,000 in 2005 dollars).

June 16, 1918. Rapidly melting snows caused flooding at Livingston on June 16 and 17. Ninth Street Island and Livingston Island were covered to a depth of 2 feet, and the bridge between Livingston and Ninth Street Island collapsed. Twelve homes and three sheds in the Riverside Addition were flooded with 1 to 3 feet of water, and many streets were damaged. Damages were estimated at $8,000 in 1918 dollars ($102,000 in 2005 dollars).

June 10, 1921. The flood crest reached Livingston on June 10 and receded the same night. A major portion of Ninth Street Island was inundated damaging gardens and roads. The upstream end of Livingston Island, including a tourist camp, was flooded. The dam at the upstream end of Sacajawea Lagoon prevented major damage. Damages were estimated at $1,200 in 1921 dollars ($13,000 in 2005 dollars).

May 27, 1928. Rapidly melting snows in the upstream basin caused flooding at Livingston on May 27, and floodwaters began to recede on May 29. Six homes on Ninth Street Island had first-floor flooding and four homes had their grounds flooded. The upstream end of Livingston Island was flooded. Floodwaters filled Sacajawea Lagoon. One section of the bridge spanning the old channel at Sacajawea Park was destroyed by floodwaters. Damages were estimated at $6,900 in 1928 dollars ($77,000 in 2005 dollars).

[35] Governor's Upper Yellowstone River Task Force, www.upperyellowstonerivertaskforce.org
[36] National Flood Insurance Program, City of Livingston Flood Insurance Study, May 19, 1987.

June 1937. The June 1937 flood, the most damaging on record for Fleshman Creek, resulted from heavy rains in the upstream drainage area. The creek overtopped its banks upstream from the Northern Pacific Railway tracks, and floodwaters followed the railroad northeastward, overtopping the tracks and flooding several blocks in the business district of Livingston. Damages were estimated at $80,000 in 1937 dollars ($1,085,000 in 2005 dollars).

June 20, 1943. The Yellowstone River began to rise at Livingston on June 14, and the flood reached its peak on June 20. Ninth Street Island was covered with 2 to 3 feet of water with damage to eight homes, a gravel plant, and roads. The golf course and a barn were flooded on Livingston Island. Water came within 2 inches of overtopping the levee. The maximum discharge at Livingston was 30,600 cfs. Damages were estimated at $2,600 in 1943 dollars ($29,000 in 2005 dollars).

June 4, 1948. Rapidly melting snows caused flooding at Livingston on June 4. On Ninth Street Island, several residences were surrounded by water, and on Livingston Island the golf course had minor damage. The maximum discharge was 26,800 cfs. Damages were estimated at $200 in 1948 dollars ($2,000 in 2005 dollars).

June 1950. The June 1950 Fleshman Creek flood, which covered nine city blocks, resulted from heavy rains. House foundations, city streets, sewage facilities, and lawns were damaged. Damages were estimated at $60,000 ($486,000 in 2005 dollars).

May 1951. The May 1951 flood, which covered about the same area as the June 1950 flood, was caused by rapid melting of late snowfall. Damages were estimated at $60,000 ($451,000 in 2005 dollars).

June 22, 1971. Unseasonably warm weather caused melting of heavy snow cover upstream from Livingston. Heavy runoff caused the Yellowstone River to rise to a peak flow and stage of 29,200 cfs and 8.45 feet, respectively. Ninth Street Island was flooded to a depth of approximately 1 foot.

June 21, 1974. Warm temperatures, coupled with an exceptionally heavy mountain snowpack, caused flooding in the Livingston vicinity that reached a peak stage of 9.08 feet on June 21 at the US Geological Survey (USGS) gauge near Livingston. The National Weather Service called it the worst flooding in Livingston since 1943. The Ninth Street Island bridge and Vista View Road from the Main Street bridge to the golf course were closed. The school football and track fields were inundated. Much of Ninth Street Island was flooded, even though valiant attempts were made to keep out the floodwaters by dike construction and sandbagging. The Burlington-Northern Railroad bridge near Riverside Addition was damaged by the floodwaters.

June 1996. The Yellowstone River rose above flood stage and peaked at approximately 33,000 cfs at Livingston. The flood was the result of rapid snow melt and heavy rains. Approximately 150 homes from Cooke City to Fleshman Creek were evacuated. One house on Ninth Street Island was partially destroyed and another sustained flood damage. Many residences on Highway 89 South also sustained significant flood damage. Approximately 200 homes in all were reported have sustained some sort of damage with additional agricultural losses. Erosion along the river was significant, and there were numerous bridge, road, and culvert washouts. Sacajawea Park was flooded for nearly four days with damages to the Livingston Civic Center. Phone service was lost for a time, and dikes were reported to be failing. County Resolution # 562 designated an emergency mil levy of 2 mils be used for the repair of bridges, roads and homes damaged from June 6-18, 1996. Montana Disaster Declaration (Executive

Order 12-96) dated June 10, 1996, claims $175,870 in personnel costs. Montana Executive Order 13-96 then closes the Yellowstone River to recreation. County records show the emergency response cost Livingston $24,000 and Park County $40,000. Damages to public infrastructure were estimated at $849,456 and $425,728 for private property, and therefore, totaled over $1,275,000.

June 1997. A record snowpack with record water content began to melt resulting in a peak flow of approximately 36,000 cfs recorded at the river gauge station near Livingston. The flood event caused serious erosion to many stream banks and major gravel deposits in some sections of the Yellowstone River channel. Flood waters also damaged many county roads and washed out culverts. The majority of residential damage was south of the city of Livingston. Damage included flooded basements, first floors, and the total loss of one house due to bank erosion. County Resolution # 591 declared a flood emergency on the Yellowstone River. Recreational use from Point of Rocks to Springdale was prohibited. Damages to public infrastructure were estimated at $411,421 and $205,210 for private property, therefore, totaling over $616,000.

The following creeks and rivers caused various forms of damage in the 1996 and 1997 floods: Yellowstone River, Shields River, Six Mile Creek, Tom Minor Creek, Soda Butte Creek, Cottonwood Creek, Fleshman Creek, Mill Creek, Big Creek, Eight Mile Creek, Cinnabar Creek, Rock Creek, Billman Creek, and Bear Creek.

Historically, we can see that the two primary sources of damaging floods for Park County are the Yellowstone River and Fleshman Creek. All floods have been associated with rapidly melting mountain snowpack or heavy rains over key drainages. Flooding by Fleshman Creek is usually in the west portion of the City of Livingston. This tributary to the Yellowstone River floods primarily from intense rainfall in the hills north and west of Livingston. Some of the heaviest damage to Livingston has been due to the floods from Fleshman Creek. Table 4.45 gives a summary of flood events and the associated damages.

Table 4.45 Park County Flood Events and Damages

Date	Location	Damages	Damages in 2005 dollars
June 4, 1894	Yellowstone River	$11,300	$232,000
June 16, 1918	Yellowstone River	$8,000	$102,000
June 10, 1921	Yellowstone River	$1,200	$13,000
May 27, 1928	Yellowstone River	$6,900	$77,000
June 1937	Fleshman Creek	$80,000	$1,085,000
June 20, 1943	Yellowstone River	$2,600	$29,000
June 4, 1948	Yellowstone River	$200	$2,000
June 1950	Fleshman Creek	$60,000	$486,000
May 1951	Fleshman Creek	$60,000	$451,000
June 22, 1971	Yellowstone River	Unknown	Unknown
June 21, 1974	Yellowstone River	Unknown	Unknown
June 1996	Yellowstone River	$1,275,000	$1,587,000
June 1997	Yellowstone River	$616,000	$750,000
TOTAL			$4,814,000

Riverine flooding has historically caused the most damages, however, some urban flash flooding has also occurred. On August 5, 1993, heavy rains caused street flooding throughout the City of

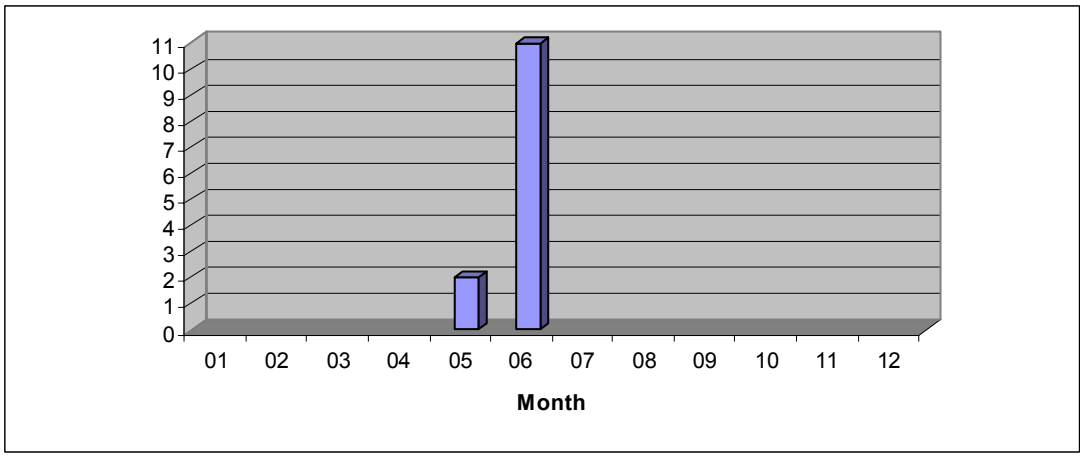
Livingston. On July 12, 2001, a similar event occurred and four feet of water was reported in the B Street underpass with several inches of water running through the area roadways.

Probability

Flooding probabilities are shown through the mapping of the floodplain. The 100-year floodplain has a 1% probability of being exceeded in any given year. Flooding has been noted 13 times since 1894 in Park County with approximately $4,814,000 in damages (2005 dollars). Based on the historical record over the past 111 years, a damaging flood occurs on average once every 8-9 years (111 years / 13 events) at a cost of approximately $370,000 ($4,814,000 / 13 events) or $43,400 per year ($4,814,000 / 111 years).

Figure 4.46 shows the months when flooding events have occurred. This figure and the historical data clearly show that flood events typically occur during the month of June in Park County and occasionally in May.

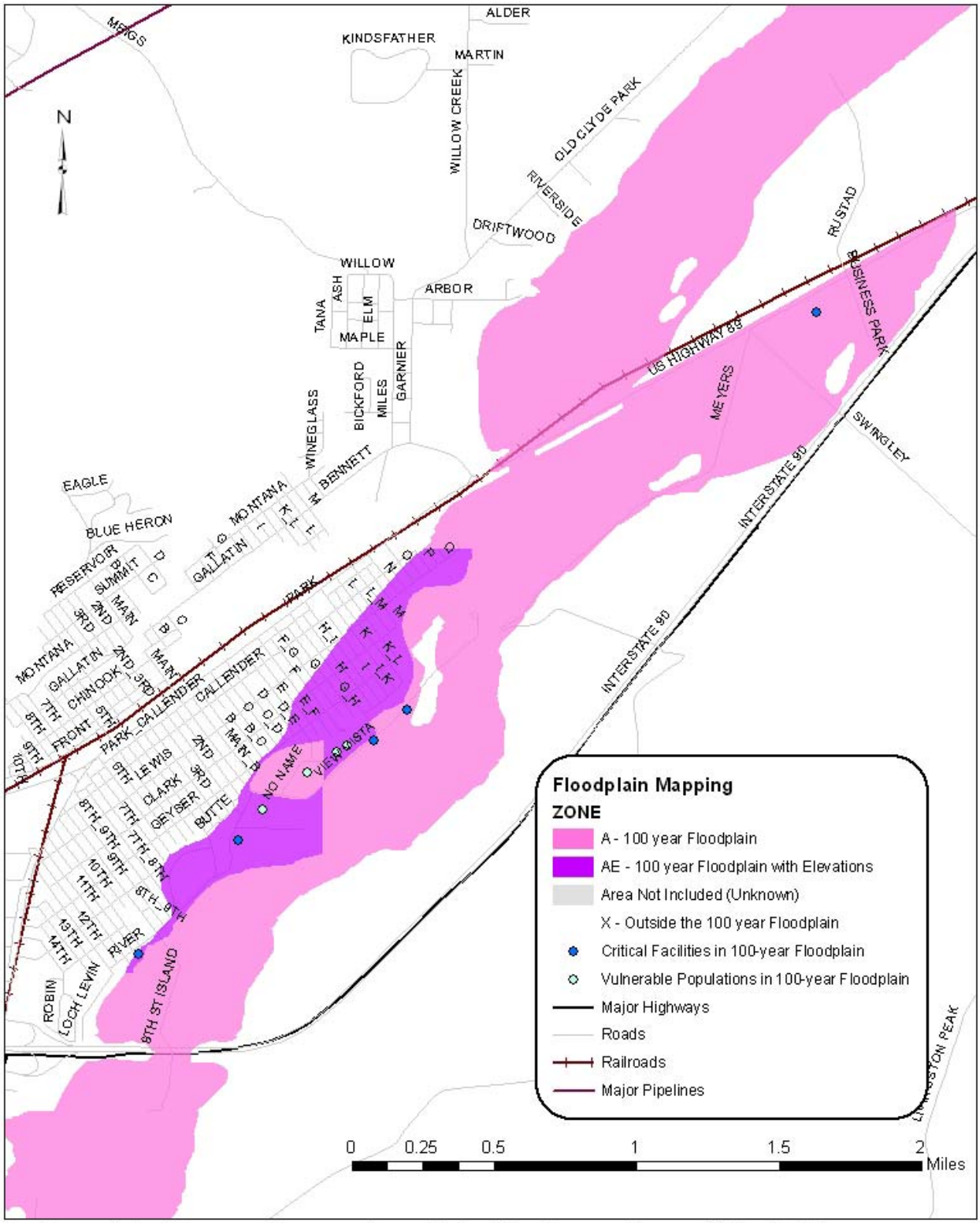
Figure 4.46 Park County Flood Events By Month



Mapping

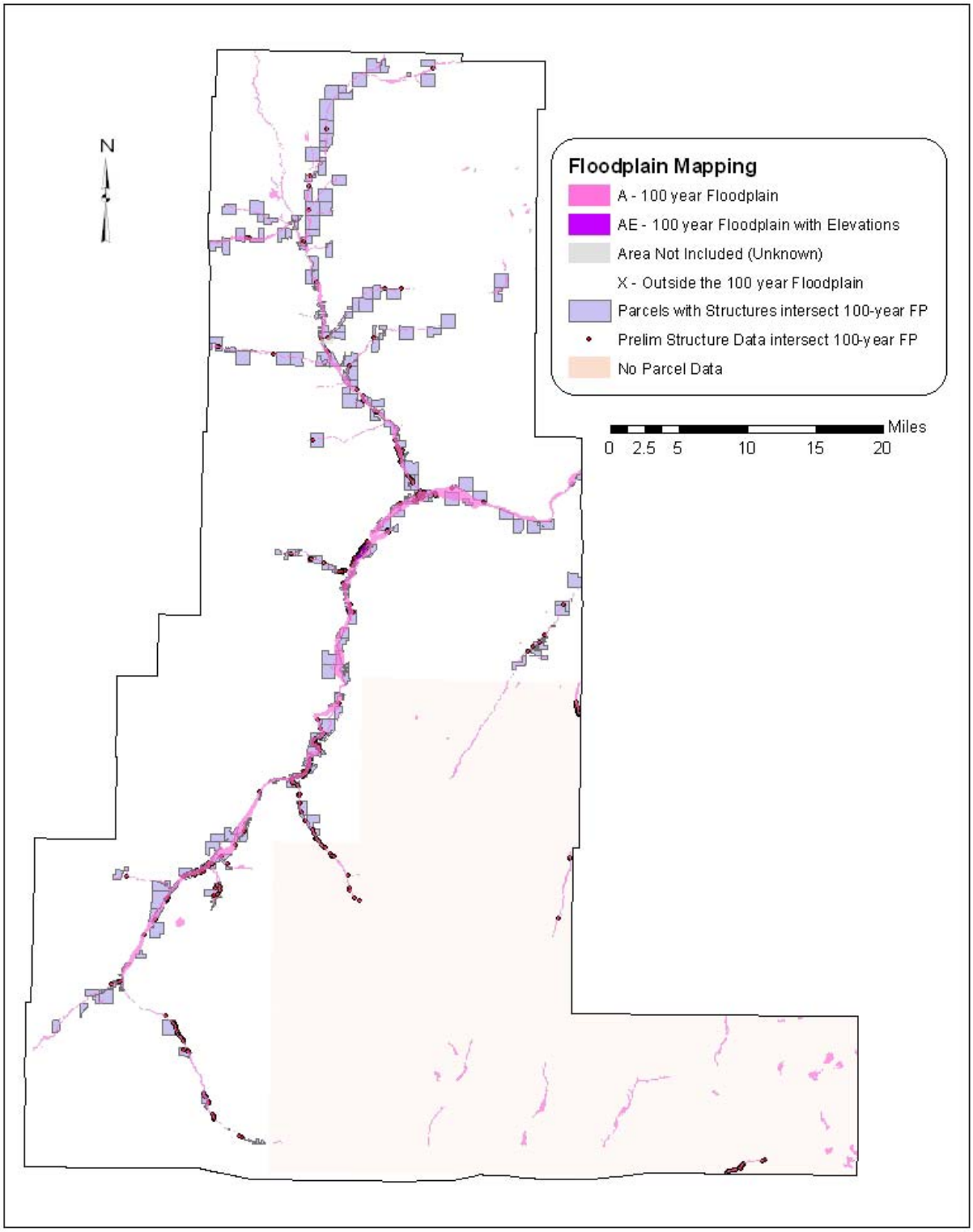
In addition to the floodplain mapping shown in Maps 4.39 through 4.44, the mapping can be used to show the relationship of critical facilities and structures to the floodplain. Map 4.47 shows the critical facilities and vulnerable populations within the digital boundaries of the 100-year floodplain in the Livingston area. Maps 4.48 and 4.49 show the structures within the 100-year floodplain.

Map 4.47 Livingston Area Critical Facilities and Vulnerable Populations in the 100-year Floodplain



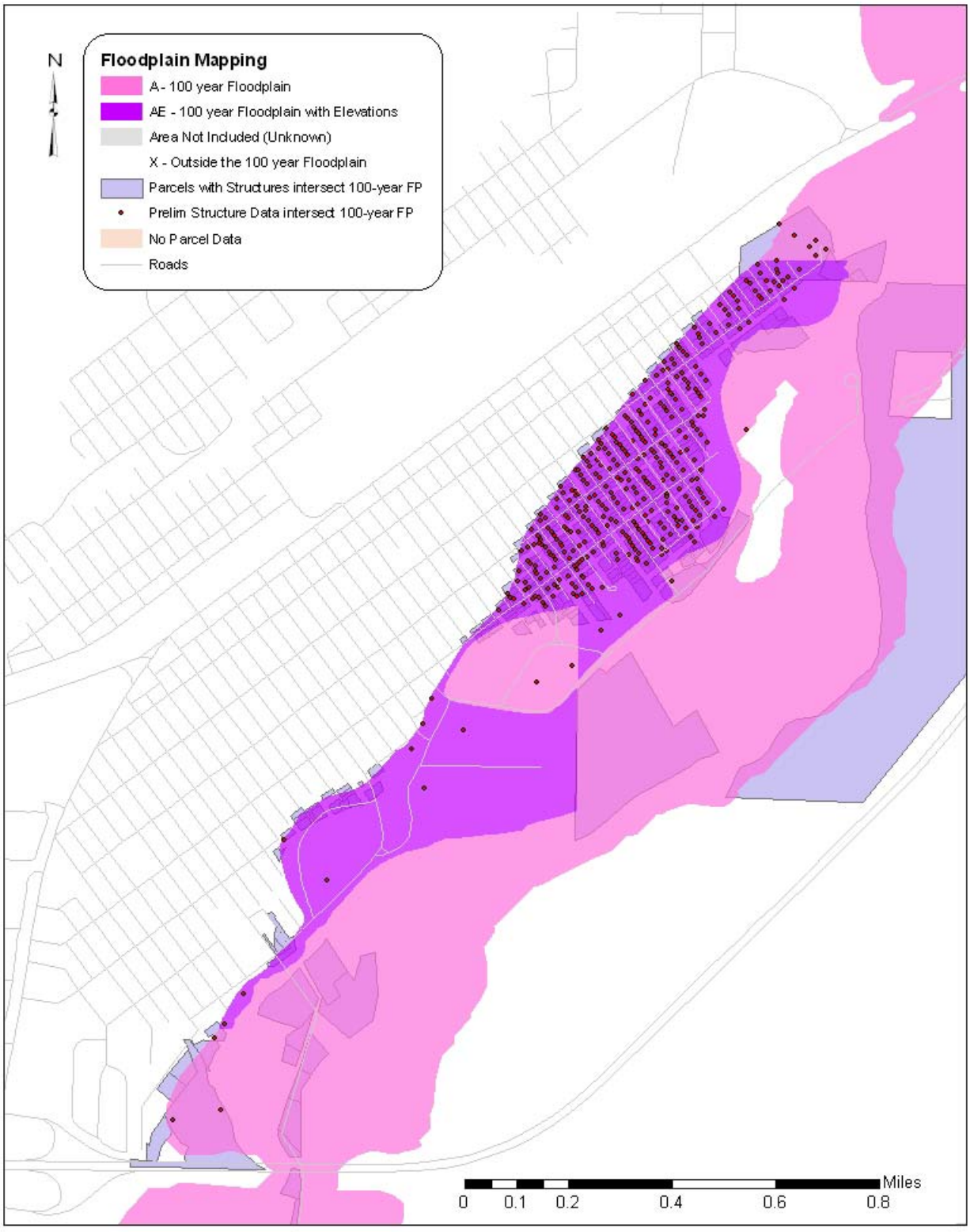
Data Source: Federal Emergency Management Agency, National Flood Insurance Program, Q3 Floodplain Data

Map 4.48 Park County Structures and Parcels with Structures Intersecting the 100-year Floodplain



Data Source: Federal Emergency Management Agency, National Flood Insurance Program, Q3 Floodplain Data

Map 4.49 Livingston Structures and Parcels with Structures Intersecting the 100-year Floodplain



Data Source: Federal Emergency Management Agency, National Flood Insurance Program, Q3 Floodplain Data

Associated Hazards and Other Factors

Excessive rainfall and heavy snows associated with flooding, both riverine and flash, can be related to other hazards. Landslides and mudslides are often attributed to saturated soils and flooding. Flood conditions in and around dams can be a factor in causing dam failures. During the summer, severe thunderstorms can bring heavy rain along with the wind, hail, and tornadoes, especially if they are slow moving. Often the runoff causes sediment problems in addition to the flooding. Telephone communications can also fail during flood events. The telephone service to Livingston is provided along the railroad tracks in the floodplain. During the 1996 flood event, telephone service was lost. These additional hazards can be factors during flood events.

A factor making a difference in flood prevention is the community. Park County has applied various mitigation techniques over the years to try to prevent impacts from flooding. The US Army Corps of Engineers has conducted emergency bank protection on the left bank of the Yellowstone River between 11th and 12th Streets. A temporary levee constructed around the City of Livingston in 1996 still exists. Rip rap and other streambank stabilization projects have been conducted on private and public property along the Yellowstone River, particularly after the 1996 and 1997 events. The non-construction projects mitigating flood impacts include the establishment of floodplain development regulations in Park County and the City of Livingston including the restriction of septic and drain fields within 100 horizontal feet or 4 vertical feet of the 100-year floodplain. Real estate disclosures are also required for properties in the 100-year floodplain.

Vulnerability

Critical Facilities

An analysis of the floodplain shows several critical facilities are in the 100-year floodplain. A GIS analysis using the Q3 floodplain data and the critical facilities and vulnerable populations database identified the facilities that are estimated to be in the floodplain. A significant limitation with this approach is that the Q3 datasets is inexact and the results should only be used for planning purposes and are not actual flood zone determinations. This approach essentially identifies the critical facilities at greatest risk from flooding. These critical facilities and vulnerable populations are:

- Livingston Civic Center
- Park County Search and Rescue *Replacement Value: $133,178*
- Park County Fairgrounds *Replacement Value: $2,654,155*
- Park Clinic
- Park Electric Cooperative Offices
- Cooke City Compactor *Replacement Value: $128,742*
- Saint Mary's School
- East Side School, Sleeping Giant Middle School, & Special Needs
- Park Senior High School
- Saint Mary's Preschool

Ultimately, these critical facilities can be expected to lose their functionality and sustain damages during a major flood.

The vulnerabilities to flash flooding are harder to quantify without specific hazard data. In Montana, however, flash flooding has been known to be most problematic to public infrastructure such as roads.

As history has shown, flood events frequently wash out roadways in Park County. Specific critical facilities have not been identified as more susceptible to flash flooding.

Potential Losses

Using the same methodology as was used for the critical facilities analysis, land parcels were compared to the location of the 100-year floodplains. In this analysis, the tax appraisal of any buildings located on that parcel was used to determine if a structure exists on that parcel, and if it one does, what its value may be. In total, 1,070 buildings worth $117,027,130 were on parcels that coincided with the 100-year floodplain. This methodology isn't ideal because a portion of a developed parcel of land may be in floodplain, but the structure may not be. Park County is in the process of mapping all the structures in the county, and the dataset is about halfway complete. Using the preliminary, incomplete structure data, 655 structures were determine to be in the floodplain based on the Q3 FEMA floodplain digital data. This data is not perfect but is useful for determining estimates for potential losses. Taking the difference between the two datasets since the first probably overestimates the number of structures in the floodplain and the second underestimates it, 863 structures are estimated to be in the floodplain in Park County. Based on the tax assessed values, those buildings are estimated to be worth $94,387,302 in total exposure. These figures lead to the following loss estimates for planning purposes:

- 863 structures are estimated in the 100-year flood inundation area with a total estimated structure value exposure of $94,387,302.
- In most cases, many of the structures would only have moderate, minor, or no damage and not all floodplain areas would likely be affected in one event, so an estimate of 20% is used as the damage factor.
- $94,387,302 total estimated structure value x 20% damage factor = $18,877,460 estimated structure losses.

A local conservation group initiated a more in-depth study using aerial photographs and FEMA floodplain maps along the Yellowstone River near and south of Livingston. "The Greater Yellowstone Coalition, in collaboration with the Geographic Information and Analysis Center at Montana State University-Bozeman, initiated this project out of concern that uncontrolled development in the 100-year floodplain poses the single greatest threat to the ecological integrity of the Upper Yellowstone River. The study focused on the stretch of river in Park County from Corwin Springs downstream to the Interstate 90 bridge in the City of Livingston—a distance of approximately 60 river miles. This section was chosen due to the rapid pace at which floodplain development is occurring in Paradise Valley and its high potential to degrade that area's remarkable natural values. Using a Geographic Information System (GIS), we found that the number of structures (homes, garages, barns, sheds, and other outbuildings) in the 100-year floodplain increased by 56.7 percent from 1980 to 2000. To put these figures in perspective, Park County's population increased by only 23.8 percent over the same period, meaning that floodplain development occurred at nearly two and a half times the rate of countywide population growth."[37] The study found 594 structures were located in the floodplain through the studied stretch of river in 2000, a 56.7% increase from 1980. Of the 594 structures, 211 are considered to be residences. This study did not consider the entire Park County floodplain, but provides better estimates than shown here for the stretch that was studied.

[37] Greater Yellowstone Coalition, Tempting Fate, Development in the 100-year Floodplain of the Yellowstone River. January 2002. www.greateryellowstone.org.

As of December 2004, the City of Livingston had 103 flood insurance policies in force insuring $10,883,100 in property. The unincorporated areas of Park County had 79 policies insuring $10,143,100. Only about 5% of the structures estimated in or near the floodplain are protected by flood insurance. Montana Department of Natural Resources and Conservation, the state floodplain management agency, reports that Park County has six repetitive loss properties under the National Flood Insurance Program. Two of these properties are located on Ninth Street Island and one each on Lone Ranger Subdivision, Old Highway 10, Old Clyde Park Road, and Shields River Road. To date, $118,843 have been paid out of the National Flood Insurance Program on these properties alone.

Comparing the 100-year floodplain to the road network in Park County, approximately 250 miles of roadway can be estimated to be in the floodplain.

Potential Population Impacts

Due to the terrain and hazard areas in Park County, the population is considered to be at moderate risk for riverine and flash flooding. Some warning does exist, particularly with riverine flooding, but rapidly occurring events may leave the population unprepared and in a dangerous situation. The impacts from flash flooding could be even greater in areas downstream of wildfire burn areas. Flash flooding often occurs without warning. The population estimated in the 100-year floodplain is 1,640 people (863 structures x 1.9 people/structure). The population in flash flood areas is unknown as flash flood can occur almost anywhere.

Impact of Future Development

The regulations for development in flood prone areas vary by jurisdiction in Park County. The City of Livingston and its donut area prohibits development, unless agricultural, in the floodway. Its regulations do not restrict development in the floodplain but does require meeting the standard National Flood Insurance Program (NFIP) requirements. The Town of Clyde Park, not mapped under the NFIP, does not participate in the program, nor does it have floodplain regulations. Development is unrestricted when it comes to flood considerations. Park County, a mapped community under the NFIP, has the usual floodplain regulations, but also has a 150 foot minimum construction setback from the mean high water mark on the Yellowstone, Shields, and Boulder Rivers and a 100 foot minimum on all other perennial streams and lakes. Developers are also required to survey and submit data when constructing near live stream drainage areas not identified on floodplain mapping.

Development continues to occur in and around the floodplain in Park County and Livingston. This development is required to meet the minimum standards of the National Flood Insurance Program and the additional provisions made by the governing body. Future development is likely to continue, given the growth in the area, but the floodplain regulations are mitigating some of the potential losses from that development.

Data Limitations

The greatest limitations when analyzing the flood risk in Park County are two key factors: a lack of digital structure data showing where structures are situated with respect to the floodplain (currently being addressed by the Park County GIS Department) and old, outdated floodplain mapping with many unmapped flood prone areas. Some sections of the Yellowstone River are currently being remapped.

These data limitations prohibit a detailed study of the potential losses from any given flood. Historical records also often lack definitive figures on the damages to private property.

GROUND TRANSPORTATION ACCIDENT

Description

In Park County, a ground transportation accident, for the purposes of this plan, includes any large scale vehicular accident involving mass casualties. The most likely locations for an incident of this magnitude would be on Interstate 90 or on Highway 89. Interstate 90 crosses central Park County in an east-west direction. This Interstate is widely used by large trucks, area residents, and distance travelers. Highway 89, south of the Interstate, connects Interstate 90 to Yellowstone National Park and is used by tourists visiting the Park, local residents, and as a shipping route to the Park and points south into Wyoming. Highway 89, north of the Interstate, serves as the primary route for many rural communities in northern Park County and beyond.

History

Many motor vehicle accidents occur each year in Park County, and occasionally fatalities do occur, but a major incident requiring a significant emergency response only occurs on occasion. In the early 1980's, local firefighters recall a four-car accident on Highway 89 south of Livingston, in which 14 people were treated, many of whom were deaf. Then, on June 17, 1999, 12 miles south of Livingston on Highway 89, a truck and tourist bus accident killed one person and injured 26 others. That accident involved many foreign, non-English speaking tourists.

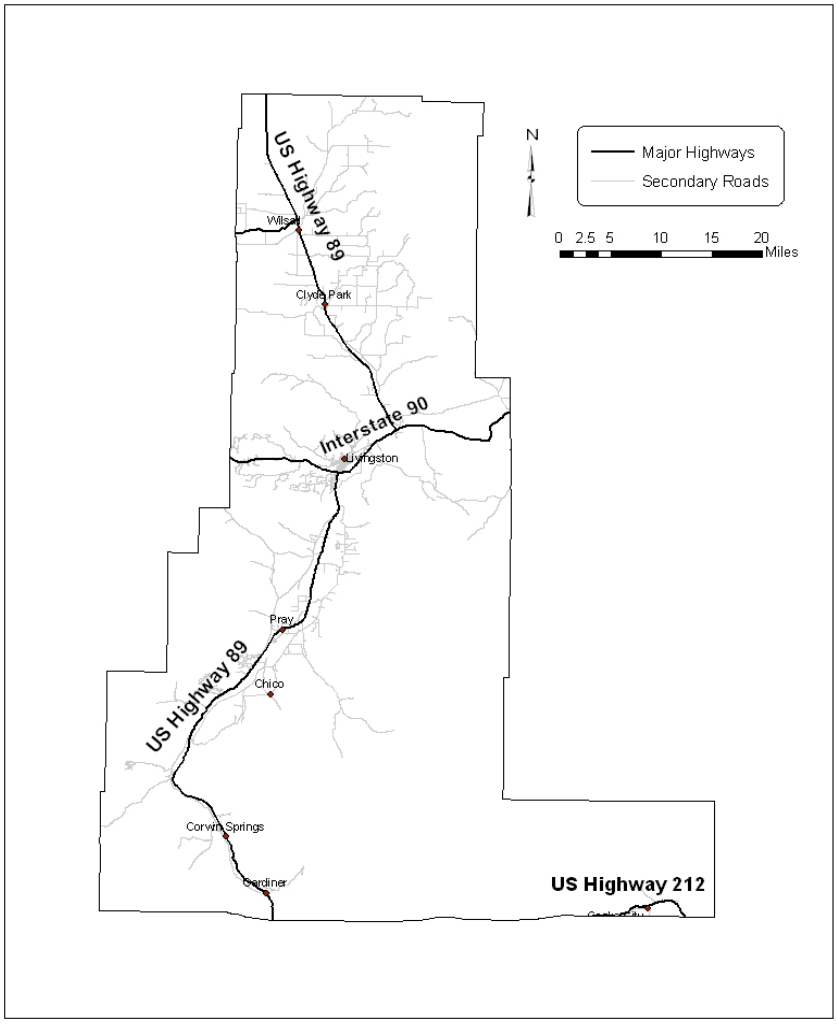
Probability

The probability of a major ground transportation accident is considered moderate based on the historical occurrence and recent call increases. The Park County Rural Fire Department has seen a jump in the number of motor vehicle responses from about 12 in the 1980's to over 100 today. Therefore, despite a relatively low history of major ground transportation accidents, the increase in motor vehicle accident responses by one local fire department leads to the assumption that the probability of a major ground transportation accident is increasing. The probability of a large wreck with mass casualties is further increased during the frequent snow storms, periods of poor visibility with blowing snow or smoke, and during times of heavy tourist traffic.

Mapping

Map 4.50 shows the major highways and the secondary roadways in Park County.

Map 4.50 Park County Highways



Associated Hazards and Other Factors

The additional hazards associated with a ground transportation accident are the obvious concerns for hazardous material releases. Any ground transportation accident involving the transport of hazardous materials increases the complexity and potential damages from that accident. Some hazards may even cause the accident such as winter storms, wildfires, earthquakes, and strong winds. Almost any hazard can cause or aggravate a ground transportation mass casualty incident.

Vulnerability

Critical Facilities

The critical facilities are not anticipated to be impacted by a ground transportation accident. A critical facility could be damaged in or made inaccessible from the impact of an accident, but the likelihood is considered low and uniform throughout the county.

Potential Losses

Potential losses from a ground transportation accident include vehicular losses, property damages, and roadway damage. Should vehicle fluids or hazardous materials seep into a water supply, that water body would also be threatened. Typically, most losses from a ground transportation accident are covered by insurance. Should the incident be large enough, the largest expenditures would probably be in responding agency costs.

Potential Population Impacts

Population losses are highly likely in ground transportation accidents. A ground transportation accident has the potential to kill and injure large numbers of people. Any accident involving a bus or many vehicles has the potential for casualties numbering from 10 to 100. Therefore, the potential for large population losses is considered moderate.

Impact of Future Development

Future development, except for the associated increase in vehicles in the area, will not impact or will just slightly increase the probability of a large ground transportation accident. Otherwise, the specific locations of where development occurs should not significantly affect the vulnerabilities from this hazard.

Data Limitations

Without much history of ground transportation accidents with mass casualties in Park County, the ability to assign a probability and possible losses to this hazard is difficult. This hazard profile will always remain somewhat general unless a detailed transportation study is conducted countywide.

HAZARDOUS MATERIALS RELEASE

Description

A hazardous material release is the contamination of the environment (i.e. air, water, soil) by any material that because of its quantity, concentration, or physical or chemical characteristics threatens human health, the environment, or property. An accidental or intentional release of materials could produce a health hazard to those in the immediate area, downwind, and/or downstream. A hazardous material release can come from a fixed facility or via its transportation through the area.

The Park County Hazardous Material Plan, dated 2003, lists and rates the fixed facilities housing hazardous materials in the county. Please refer to that plan for the full listing of hazardous material fixed facilities. Those identified as high hazard can be found in Table 4.51.

Table 4.51 High Hazard Fixed Hazardous Materials Facilities[38]

Business/Location	Address	Community	Material
B Street City Well	"B" & Lewis Streets	Livingston	Chlorine - 2, 150lb
Bearclaw Petroleum	Highway 10 West	Livingston	Petroleum Products, Gasoline, Diesel at Bulk Plant
Bumper to Bumper	210 South Main Street	Livingston	Petroleum Products, Oxygen, Propane
City Pool	City Park	Livingston	Chlorine
County Extension Storage Shed	415 ½ East Callender	Livingston	Tordon, Arsenic
D Street City Well	"D" & Geyser Streets	Livingston	Chlorine - 2, 150lb
L Street City Well	"L" and Geyser Streets	Livingston	Chlorine - 2, 150lb
Montana Rail Link	704 E. Gallatin	Livingston	Oxygen, Acetylene, Propane
Q Street City Well	"Q" & Lewis Streets	Livingston	Chlorine - 2, 150lb
Sewage Treatment	316 Bennett Street	Livingston	Chlorine 2 tons, Sulfuric Acid
Tri-Valley Petroleum	Highway 10 West	Livingston	Petroleum Products, Gasoline, Diesel at Bulk Plant
Tri-Valley Petroleum	102 North "I" Street	Livingston	Petroleum Products, Gasoline, Diesel at Gas Station
Clyde Park Town Hall	1st & Miles Streets	Clyde Park	Calcium Hypochlorite and Propane
Amerigas	304 4th Street	Gardiner	Propane
Gardiner Reservoir	Hellroaring & Granite	Gardiner	Chlorine - 2, 150lb
Gardiner Sewage Plant	Hwy 89 & Park Streets	Gardiner	Chlorine
Gardiner Water District	Hwy 89 North	Gardiner	Chlorine - 2, 150lb
Shields Valley Grain	304 East Clark	Wilsall	Elevator, Various Chemicals
Wilsall Water District	Clark & Darling Streets	Wilsall	Calcium Hypochlorite

A major fuel pipeline, the Yellowstone Pipeline, runs through central Park County, just north of Livingston and Interstate 90. This pipeline transports refined petroleum products between Billings, MT and Spokane, WA. Should an explosion or leak occur on this pipeline, a large hazardous material release of the fuel and/or fumes could result and threaten the population and property.

The most likely locations for a transportation-related hazardous materials release is on Interstate 90, Highway 89, or the active railways. Interstate 90 crosses central Park County in an east-west direction.

[38] Park County Hazardous Material Plan, 2003.

This Interstate is widely used by vehicles transporting hazardous materials. Highway 89, south of the Interstate, connects Interstate 90 to Yellowstone National Park and is used as a shipping route to the Park and points south into Wyoming. Highway 89, north of the Interstate, serves as the primary route for many rural communities in northern Park County and beyond. For the most part, the railroad parallels Interstate 90, except for where it goes through the City of Livingston. Only the east-west railroad sections are currently active with an additional short section used south through Livingston. The railroad is owned and operated by Montana Rail Link with the short section through Livingston operated by RY Timber. Railways exist along Highway 89, but are no longer active. If a transportation-related release occurred near populated areas or water supplies, serious human impacts could result.

History

Historically, incidents have been small enough to prevent a large evacuation and long-term impacts however, hazardous materials incidents do occur in Park County. The incidents logged with the National Response Center follow.

July 14, 2003. Fuel oil was reportedly spilled onto the ground near Corwin Springs by a tanker truck.
February 18, 2002. A tractor trailer truck overturned in icy road conditions on Interstate 90 between Mission Creek and Springdale and spilled 125 gallons of diesel fuel from a saddle tank.
July 1, 2001. About 40 gallons of transformer oil were released after being struck by a vehicle on High Ground Avenue in Livingston.
April 7, 2000. Raw sewage was reported to have backed up into a trailer on North C Street.
November 20, 1998. About 1,500 gallons of oil spilled from an open storage tank valve at the Livingston Rebuild Center.
January 19, 1997. A storage tank leaked 100 gallons of ferric chloride at TVX Mineral Hill Mine in Jardine.
June 21, 1996. A portable diesel fuel tank leaked and then ruptured near Cooke City and about 350 gallons of diesel oil was spilled.
February 22, 1994. About 1,500 barrels of unleaded gasoline spilled from a failed cooling line in Springdale.
September 8, 1990. About 30 gallons of transformer oil spilled after a pole was knocked over by the wind in the east end of Wilsall.
April 10-14, 1990. About 4,000 gallons of fuel oil and 12,000 of gasoline leaked from an underground storage tank in Corwin Springs. Approximately 300 gallons entered the Mol Huron Creek drainage.

A local firefighter also recalled a response to a railroad car leaking deck sealer in the late 1980's.

Probability

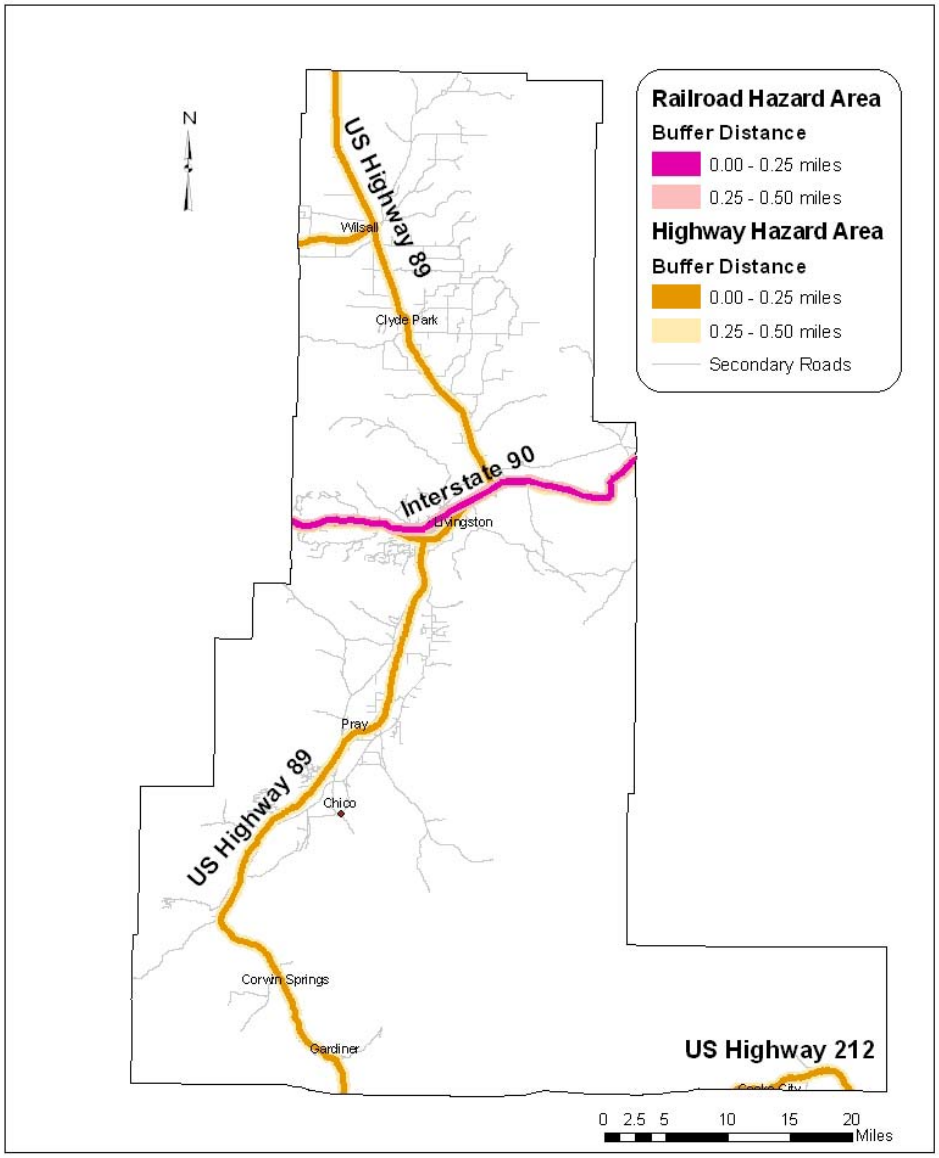
The probability of a hazardous materials release can only be realistically assessed qualitatively. The history of events in Park County is moderate with ten events over the past 15 years, none of which have resulted in a disaster declaration. The exposure, however, is high with Interstate 90 and an active railroad passing within close proximity to critical facilities and Livingston. The probability of a significant release is considered greater along the railroad since the US Department of Transportation regulates hazardous materials on commercial vehicles, has specific regulations regarding mixed loads

and amounts, and provides enforcement, whereas, the railroad system does not have as extensive control measures. Therefore, the probability of a hazardous materials release that would require a significant government and public response is considered high.

Mapping

As with many hazards, the degree of risk to a particular area is hard to quantify, however, buffer zones were created around the major hazardous materials transportation routes to show the areas that would most likely be affected in a hazardous materials incident. Of course, the entire County is at some risk for a hazardous material release, but the areas shown in Map 4.52 are at the greatest risk given their proximity to areas where hazardous materials can typically be found.

Map 4.52 Hazardous Materials Transportation Buffer Zones



Associated Hazards and Other Factors

Hazardous material releases can be accidental or intentional. Accidental causes can be due to a ground, air, or railroad accident. Almost any other hazard event may also lead to a hazardous material release. Destruction of a facility or transportation infrastructure may lead to a hazardous material release. Examples include earthquake, flooding, wildfire, avalanche, landslide, dam failure, severe thunderstorm, tornado, wind, structure fire, or even a volcano. Intentional releases may be related to terrorism or a domestic disturbance. A hazardous material release, if severe enough, could lead to civil unrest, a fiery explosion, or utility failure. Hazardous material releases could very likely aggravate almost any other hazard.

Vulnerability

Critical Facilities

The buffers around the highways and railways represent the areas that have an enhanced risk for a hazardous materials release. Two buffer zones were established, 0.25 miles and 0.50 miles from the route. These buffer zones were chosen based on minimum evacuation radii that would be established for a typical hazardous substance release. Of course, the actual evacuation zone for an event is highly dependent on many factors including wind speed, wind direction, material released, and quantity released. Like many of the other hazards, the hazard area in an actual event will not involve the entire area at risk, but more likely only a small section of the identified area, and therefore, a small percentage of the critical facilities. Based on these buffer zones, the following figures demonstrate the critical facilities at greatest risk and the potential for one or several to be affected in an event.

- 34 of 64 critical facilities are within 0.25 miles of major highways
- 4 of 37 vulnerable populations are within 0.25 miles of major highways
    - Shields Valley Elementary
    - Springdale School
    - Gardiner School
    - Cooke City School
- 17 of 64 critical facilities are within 0.25 miles of active railroad
- 17 of 37 vulnerable populations are within 0.25 miles of active railroad

- 39 of 64 critical facilities are within 0.50 miles of major highways
- 8 of 37 vulnerable populations are within 0.50 miles of major highways
- 20 of 64 critical facilities are within 0.50 miles of active railroad
- 23 of 37 vulnerable populations are within 0.50 miles of active railroad

Since the Interstate 90 and the Montana Rail Link corridor hauls more hazardous materials that the other transportation routes, the highest risk can be assumed to be in that area. The only vulnerable population site within 0.25 miles of both is the Springdale School. The critical facilities and vulnerable populations that are within 0.50 miles of both active routes include:

- County Road Shop - Livingston
- Park Electric Cooperative Offices
- Springdale School

Potential Losses

Using the same methodology as was used for the critical facilities, the incomplete structure data, currently under development, was evaluated with respect to the highway and railroad buffer zones. The following estimates demonstrate the exposure of structures to transportation related hazardous materials incidents.

- 12% or 755 of 6,434 structures are within 0.25 miles of major highways
- 25% or 1,609 of 6,434 structures are within 0.25 miles of active railroad

- 21% or 1,350 of 6,434 structures are within 0.50 miles of major highways
- 47% or 3,055 of 6,434 structures are within 0.50 miles of active railroad

More specifically in the highest hazard area, 38 structures are within 0.25 miles of Interstate 90 and Montana Rail Link and 130 structures are within 0.50 miles of Interstate 90 and Montana Rail Link.

Fortunately, unless an explosion is present with the release, structures are typically not damaged in a hazardous materials release.

Potential Population Impacts

The population impacts from a hazardous materials release are more significant than the potential structure losses. Depending on the material, the health impacts to the public can be long and short term. Should a release occur in Livingston, the population impacts would be much greater than if one occurred in a more rural area.

Estimating the population to be roughly 2.4 people per structure (15,694 total population / 6,434 mapped structures based on the incomplete structure data), the population exposure can be estimated as follows:

- 92 people live within 0.25 miles of Interstate 90 and Montana Rail Link
- 312 people live within 0.50 miles of Interstate 90 and Montana Rail Link
- 1,812 people live within 0.25 miles of major highways
- 3,862 people live within 0.25 miles of active railroad
- 3,240 people live within 0.50 miles of major highways
- 7,332 people live within 0.50 miles of active railroad

In a hazardous materials release, those in the immediate area would have little to no warning, whereas, the population in the dispersion path may have some time to evacuate, depending on the weather conditions and material released.

Many factors will determine the true hazard area in a transportation related hazardous material release. The worst case scenario would be a release along the railroad near downtown Livingston. Given this scenario, a conservative estimate of 1,000 structures could be directly affected and/or evacuated. With an estimated 2.4 people per structures (and possibly higher for downtown Livingston), approximately 2,400 people would be at greatest risk in such an event.

Impact of Future Development

Much of the future development currently occurring is off of the major road and rail networks in the county. The potential, however, does exist for development of agricultural lands bordering the highways and railroad, particularly in the unincorporated parts of Park County. Very few restrictions are in place to prevent development in these areas.

Data Limitations

Understanding when, where, and what substances are mostly likely to be released in a hazardous materials incident is the greatest limitation in analyzing this hazard. Hazardous substances pass through Park County regularly without incident that fully describing how a release may occur and what population and structures may be affected is not possible. A study of the number and types of hazardous materials passing through Park County would help better frame this profile. A complete structure database would also allow for more accurate estimates of potential losses and population impacts. Digital mapping of the fixed facilities would allow for a more detailed analysis of vulnerabilities from a release at those facilities.

RAILROAD ACCIDENT

Description

Montana Rail Link (MRL) operates on a railroad that crosses Park County in an east-west direction, roughly parallel to Interstate 90, and passes through the City of Livingston. A very short segment runs from RY Timber to this main line. MRL is a Federal Railroad Administration Class II regional railroad with more than 900 miles of track serving 100 stations in the states of Montana, Idaho and Washington, and employs approximately 1,000 people. They operate a fleet of more than 2,100 freight cars and 120 locomotives.[39] MRL connects with Spokane, Washington, the Burlington Northern & Santa Fe Railway (BNSF) at Laurel and Helena, Montana, the Montana Western Railway at Garrison, Montana, and the Union Pacific Railroad at Sandpoint, Idaho.

History

The railroads in Park County were operated by Burlington Northern Railroad from 1970 to 1987 until Montana Rail Link assumed control of the route through Southern Montana. Table 4.53 outlines the accidents in Park County documented by the Federal Railroad Administration since 1975.

Table 4.53 Railroad Accidents in Park County, Montana[40]

Date	Reportable Damage	Casualties	Cause/Effect
July 5, 1975	$5,500	None	Human cause, 1 car derailed
October 24, 1976	$5,235	None	Human caused switch problem, 3 cars derailed
February 16, 1977	$3,900	None	Switch point worn, 3 locomotive derailed
July 22, 1978	$4,125	None	Worn flange, 2 cars derailed
October 31, 1978	$71,000	1 injury	Highway/rail collision
August 9, 1979	$105,000	None	Human caused, head-on collision
July 15, 1980	$13,420	None	Switch point worn, 3 cars derailed
August 16, 1980	$4,582	None	Roadbed settled, 3 locomotives derailed
December 20, 1980	$6,350	None	Horizontal split head, 5 cars derailed
June 1, 1981	$15,550	None	Damaged switch, 5 cars derailed
September 7, 1981	$9,000	None	Track vandalism, 4 cars derailed
November 24, 1981	$5,850	None	Human caused train handling, 5 cars derailed
February 4, 1982	$8,050	None	Movement with air hose uncoupled, 14 cars derailed
December 7, 1985	$201,500	None	Engine improperly secured, 1 locomotive derailed
December 28, 1988	$17,500	None	Head and web separation, 5 cars derailed, 2 carrying hazardous materials, both derailed, one released 10-20 gallons of No. 5 fuel oil
April 1, 1989	$21,000	None	Soft track, 3 cars derailed
May 2, 1989	$6,000	None	Human caused improper run through switch, 3 locomotives derailed

[39] Montana Rail Link, http://www.montanarail.com/, 2005.
[40] Federal Railroad Administration, Office of Safety Analysis, http://safetydata.fra.dot.gov/officeofsafety/Default.asp.

Table 4.53 (continued) Railroad Accidents in Park County, Montana[40]

Date	Reportable Damage	Casualties	Cause/Effect
February 20, 1990	$7,000	None	Wide gauge from poor tie condition, 2 locomotives derailed
September 22, 1990	$11,600	None	Brake not set, loaded coal train rolled backwards, 1 car derailed
November 29, 1990	$526,000	None	High winds blew trailers and containers off the track, 13 cars derailed
May 4, 1992	$7,615	None	Use of out-of-service track, 3 cars derailed
November 12, 1992	$7,200	None	Wide gauge at joint and soft track, 2 cars derailed, 5 cars carrying hazardous materials, none derailed
November 14, 1992	$13,800	None	Broken angle bar at switch point, 4 cars derailed
September 9, 1993	$23,500	None	Wide gauge, 5 cars derailed
October 29, 1993	$30,000	1 injury	Rear-end collision of single cars
August 7, 1995	$7,000	None	Human error, collision while switching
April 12, 1996	$19,500	None	Wide gauge, 8 cars derailed
October 22, 1996	$16,000	None	Switch point defect, 2 cars derailed, 14 cars carrying hazardous materials - none of which derailed
September 11, 1997	$10,200	None	Yard overloaded, cars collided
December 5, 1998	$12,650	None	Wide gauge, 3 locomotives derailed
May 25, 2002	$12,000	None	Brakes released by vandals, 3 cars derailed
August 7, 2003	$18,000	None	Worn switch point, 2 cars derailed
January 7, 2004	$18,091	None	Snow and ice raised rubber material at Fifth Street Crossing, damaging snow plow, and became stuck under the third car
December 11, 2004	$320,000	None	Worn switch point, empty grain car derailed and collided with train, 7 cars derailed, 23 cars carrying hazardous materials - none of which derailed

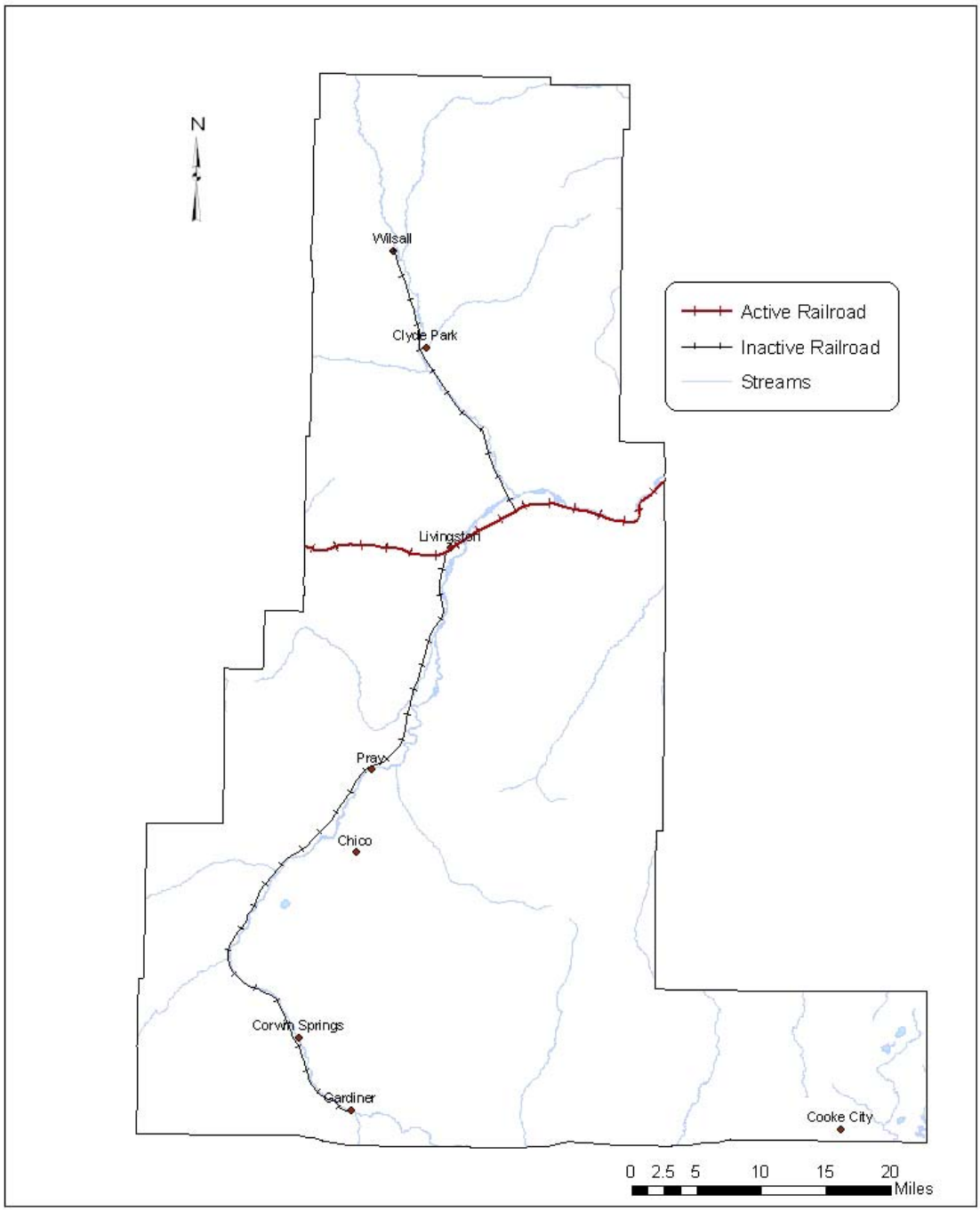
Probability

Since 1975, 34 railroad accidents have occurred resulting in $1,563,698 in track and equipment damages and 2 injuries. Using this historical record, on average, a railroad accident occurs 1.13 times per year (34 accidents / 30 years) in Park County. The average accident causes $45,991 ($1,563,698 / 34 accidents) in damage. Based on this historical record, roughly $52,123 ($1,563,698 / 30 years) is the annualized damage total. Obviously incidents do not follow averages, and therefore, the maximum and minimum damages over the past 30 years of $526,000 and $3,900, respectively, should be noted. Another important consideration in a railroad accident is the release of hazardous materials. The historical record shows this has only occurred once in the past thirty years, but the potential certainly exists as demonstrated by the number of hazardous material cars involved, but not damaged, in railroad accidents.

Mapping

Map 4.54 shows the railroad sections in Park County, both active and non-active. The only discrepancy is a section of the inactive railroad just south of Livingston is in active use by RY Timber for transportation to the active railway.

Map 4.54 Railroads in Park County, Montana



Associated Hazards and Other Factors

A railroad accident is hazardous to those in close proximity to and inside the train due to physical impacts, but others may be threatened by associated hazards. A hazardous material release is the most probable associated hazard. Those effects are described in detail in the hazardous materials hazard profile. Almost any other hazard could also cause a railroad accident. Weather conditions can damage tracks or affect the locomotives and cars. For example, strong winds can blow cars from the tracks, winter storms, cold weather, and hot weather can warp tracks, avalanches, landslides, and flooding can cover rail routes, hail and tornadoes can damage cars, and fog and smoke can limit visibility. An earthquake or volcano could also damage tracks or equipment. The possibility that a train could be used in a terrorist attack cannot be ruled out. All of these associated hazards increase the probability of a railroad accident occurring.

Vulnerability

Critical Facilities

Park County critical facilities are not to be considered at enhanced risk from a railroad accident. Certainly, the associated hazards may threaten the facilities, but the accident itself should not directly impact the critical facilities. All critical facilities and vulnerable populations are more than 250 feet from the tracks.

Potential Losses

Most of the losses from a railroad accident are paid for by Montana Rail Link or their insurance. Potential community losses are most probable to infrastructure such as roadways. Should a derailment occur on a state, county, or city road, that road could be unusable for several days or weeks. Staff time in coordinating the clean up or response could be considered additional railroad accident losses. In terms of structures that could be impacted by a derailment, 107 structures are within 250 feet of the railroad. Most accidents would probably only impact one or two structures Damages could vary in the hundreds of thousands of dollars depending on the structure or structures impacted.

Potential Population Impacts

Since the active railroad in Park County no longer serves passengers, the potential for high casualties from the impact of a railroad accident is low. The potential certainly exists, however, for casualties to railroad workers and those in the general vicinity, especially since the trains pass by community parks and near downtown Livingston. The potential for large population impacts is considered low, however, particularly when considering the historical record of only 2 injuries over the past 30 years and 34 accidents.

Impact of Future Development

Future development should have little to no impact on the railroad accident hazard. Most development is occurring in areas away from the railroad's immediate impact area. Little restrictions are in place, however, to prevent such development.

Data Limitations

The data on the railroad hazard in Park County is based on Federal Railroad Administration records. This data is sufficient in calculating the occurrence over the past 30 years. Where the data is not useful is in determining the probability of a large-scale accident involving hazardous materials. An analysis of the current railroad weaknesses, numbers and types of materials transported, and areas with the greatest potential for derailment would enhance this profile. Such information, however, would not necessarily be included in a public plan.

SEVERE THUNDERSTORMS and TORNADOES

Description

Thunderstorms in Montana develop when moisture in the air rises, often from daytime ground heating, an unstable atmospheric condition, synoptic front, or by terrain uplift, and cools higher in the atmosphere, condensing into rain droplets or ice crystals. The cloud grows as these conditions continue and the atmospheric instability allows. Lightning can be produced, with or without rain, as a charge builds up in the cloud. With the right atmospheric conditions, updrafts and downdrafts form in the thunderstorm structure. These strong updrafts and downdrafts can produce hail, strong straight-line winds, and even tornadoes.

Hail is produced when a supercooled droplet collects a layer of ice and continues to grow, sustained by the updraft. Once the hail stone cannot be held up any longer by the updraft, it falls to the ground. Park County regularly has small, pea-sized hail, but larger stones to the size of quarters or larger are possible.

Strong straight-line winds, sometimes stronger than tornadoes at over 100 mph, occur when air is carried into a storm updraft, cools rapidly, and comes rushing to the ground. Cold air is denser than warm air, and therefore, wants to fall to the surface. On warm summer days, when the cold air can no longer be supported up by the storm's updraft, the air crashes to the ground in the form of strong winds. These winds are forced horizontally when they reach the ground and can cause significant damage.

Tornadoes form when the right amount of shear is present in the atmosphere and causes the updraft and downdraft to rotate. A funnel cloud is the rotating column of air extending out of a cloud base, but not yet touching the ground. The funnel cloud does not become a tornado until it touches the ground. Once in contact with the surface, it can create great damage over a small area. Although rare, they can and do occur in south central Montana.

A severe thunderstorm is defined by the National Weather Service as a thunderstorm that produces wind gusts at or greater than 58 mph (50 kts), hail ¾" or larger, and/or tornadoes. Although not considered severe by definition, lightning and heavy rain can also accompany thunderstorms. The severe conditions are often the events that can directly cause widespread damage. Strong winds, hail, and tornadoes have capability to damage structures, infrastructure, crops, livestock, and vehicles.

History

Hail and strong winds frequently occur in thunderstorms in Park County as documented in Tables 4.55 and 4.56. [41]

[41] National Climatic Data Center, Local Storm Reports, http://www.ncdc.noaa.gov/oa/ncdc.html.

Table 4.55 Hail Events, ¾ Inch or Larger, Recorded in Park County, Montana

Date	Location	Diameter
August 15, 1955	Park County	Unknown
May 4, 1963	Park County	0.75 inches
June 30, 1966	Park County	0.75 inches
July 21, 1970	Park County	0.75 inches
July 29, 1973	Park County	1.00 inches
July 18, 1997	Livingston	1.75 inches
July 18, 1997	7 miles NE of Livingston	0.75 inches
August 18, 1997	12 miles SW of Livingston	1.00 inches
July 31, 1998	Wilsall	0.75 inches
July 31, 1998	15 miles NE of Livingston	0.75 inches
June 19, 1999	5 miles NNW of Wilsall	0.75 inches
May 30, 2002	30 miles SW of Livingston	0.75 inches
June 29, 2002	3 miles N of Emigrant	1.00 inches
August 11, 2003	Clyde Park	0.75 inches
August 5, 2004	7 miles SE of Clyde Park	0.88 inches

Table 4.56 Thunderstorm Wind Events, 58 mph or Stronger, Recorded in Park County, Montana

Date	Location	Speed/Damages
June 3, 1956	Park County	70 mph
June 15, 1956	Park County	Unknown
July 5, 1962	Park County	63 mph
August 8, 1965	Park County	60 mph
August 12, 1965	Park County	61 mph
July 20, 1966	Park County	58 mph
July 8, 1967	Park County	63 mph
July 24, 1967	Park County	66 mph
July 31, 1967	Park County	78 mph
June 13, 1968	Park County	60 mph
September 18, 1968	Park County	63 mph
June 5, 1969	Park County	58 mph
May 17, 1970	Park County	62 mph
June 27, 1970	Park County	71 mph
July 21, 1970	Park County	61 mph
August 31, 1970	Park County	59 mph
August 3, 1971	Park County	Unknown
June 26, 1972	Park County	62 mph
August 2, 1972	Park County	61 mph
May 20, 1973	Park County	61 mph
June 29, 1973	Park County	69 mph
July 11, 1973	Park County	79 mph
July 29, 1973	Park County	Unknown
August 13, 1973	Park County	69 mph
August 27, 1973	Park County	58 mph
July 21, 1975	Park County	66 mph

Table 4.56 (continued) Thunderstorm Wind Events, 58 mph or Stronger, Recorded in Park County, Montana

Date	Location	Speed/Damages
August 16, 1975	Park County	61 mph
May 16, 1979	Park County	73 mph
June 23, 1980	Park County	68 mph
July 6, 1983	Park County	67 mph
July 6, 1983	Park County	100 mph
July 8, 1983	Park County	Unknown
August 14, 1983	Park County	60 mph
August 6, 1984	Park County	58 mph
August 23, 1984	Park County	60 mph
August 24, 1984	Park County	69 mph
August 25, 1984	Park County	60 mph
May 13, 1988	Park County	81 mph
April 22, 1994	Livingston Airport	63 mph
June 25, 1994	18 miles S of Livingston	Unknown speed. Trees blown down at Pine Creek Camp Ground. One vehicle damaged by a falling tree. Damages estimated at $5,000.
August 15, 1994	Livingston	67 mph
September 8, 1994	Livingston	69 mph
August 6, 1995	Livingston	59 mph
August 24, 1995	6 miles S of Livingston	Unknown speed. Large trees blown down. One person injured by falling tree. Campers trapped by fallen trees across the road.
August 24, 1995	Livingston	59 mph
July 17, 1997	Livingston Airport	59 mph
July 17, 1997	Clyde Park	64 mph
July 17, 1997	8 miles ENE of Wilsall	61 mph Power lines knocked down.
July 18, 1997	2 miles S of Livingston	69 mph
August 3, 2001	7 miles NE of Livingston	60 mph

Despite a lack of tornadoes in Park County's weather records, in nearby Yellowstone National Park just to the south, an F4 tornado (207-260 mph) formed on July 21, 1987. The Teton-Yellowstone Tornado, as it was named, was 1.5 miles (2.5 km) wide and traveled for 24 miles (39.2 km). The tornado crossed the Continental Divide at an elevation of 10,072 feet (3.070 m).[42] Tornadoes like the Teton-Yellowstone Tornado are rare but possible in places like Park County, Montana. More likely in Park County are smaller, shorter lived, yet damaging tornadoes.

[42] Fujita, T. Theodore. The Teton-Yellowstone Tornado of 21 July 1987. *Monthly Weather Review*, Vol. 117, No. 9, pp. 1913-1940. March 24, 1989.

Probability

The history of hail and strong thunderstorm winds in Park County shows that both are fairly frequent. The data presented in the history is based on reports received by the National Weather Service in Billings, MT. Often unless the event is noticed by a trained spotter or emergency official, the event will go unreported. Therefore, many events may not have been reported or noted by observers and the statistics represent only those events that have been documented. The following statistics can be presented based on the available data.

Hail:

- 15 severe hail events since 1955
- Annual average = 0.3 events or 1 event every 3.3 years
- Largest reported size = 1.75 inches

Thunderstorm Winds:

- 50 severe thunderstorm wind events since 1956
- Annual average = 1.0 events or 1 event every year
- Highest reported thunderstorm wind speed = 100 mph

Charts 4.57 and 4.58 show the frequency of severe thunderstorm events by month. July and August are the months when most severe thunderstorms occur.

Chart 4.57 Hail Events, ¾" of Larger, in Park County, Montana by Month

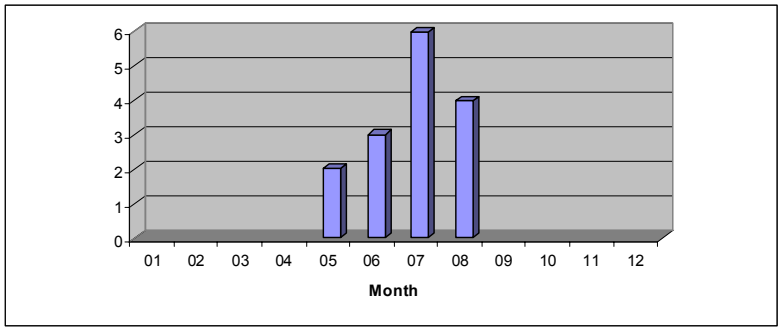
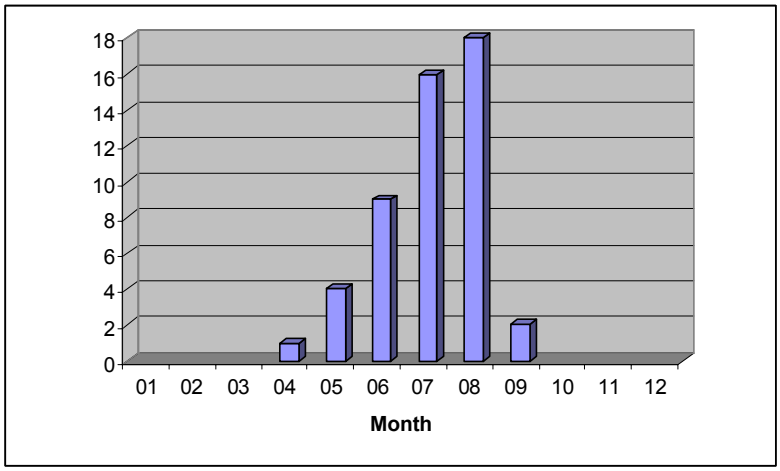


Chart 4.58 Thunderstorm Wind Events, 58 mph or Greater, in Park County, Montana by Month



Mapping

Severe thunderstorms can occur anywhere in Park County. Due to the sporadic population centers in Park County, mapping the locations of historical events would show where events have been spotted and reported from, but would not necessarily depict the hazard level from severe thunderstorms. Infrequently traveled areas may have a larger concentration of severe thunderstorm events, but because of the low population, events have gone unreported. Therefore, the risk is assumed to be the same countywide.

Associated Hazards and Other Factors

Severe thunderstorms and tornadoes can be associated with other hazards. Lightning can spark wildfire or urban fires, especially when coupled with strong winds, and heavy rains can cause flash flooding. These hazards can also contribute to ground or aircraft accidents if they interfere with travel. Fortunately, most pilots are trained to recognize hazardous weather conditions such as severe thunderstorms. Particularly severe thunderstorms can also lead to widespread power and communications failures.

Vulnerability

Critical Facilities

All critical facilities and vulnerable populations are considered to have the same vulnerability to severe thunderstorms, unless specific reinforcements have been made to protect them from strong winds. Infrastructure, namely power lines, are primarily vulnerable to high winds and falling trees. Power systems are the most likely infrastructure to fail during a severe thunderstorm. Communications towers may also topple under strong winds or large hail. Infrastructure at a reduced risk from severe thunderstorms and tornadoes include those utilities located underground or within reinforced structures.

Potential Losses

With the entire county at risk from severe thunderstorms and tornadoes, estimates of damages are hard to determine. Realistically, an event involving a tornado or severe thunderstorm would most likely significantly affect only a small area. If that area, however, was in a developed part of the county, 10-20 homes could be damaged. Fifteen homes at a damage factor of 30% would result in roughly $440,550 in damages. Vehicles damaged by hail or falling debris would be additional losses. Potential losses could also include losses to agriculture. Livestock and crops can be significantly damaged by large hail and strong winds, and therefore, result in diminished profits.

Potential Population Impacts

The National Weather Service in Billings, MT warns for severe thunderstorms and tornadoes when recognized on Doppler radar or by other means. The warnings are broadcast over NOAA weather radio and may be transmitted over television scrolls and cable networks such as the Weather Channel. Some events have 15-20 minutes warning time and others have little to no warning. Depending on the

effectiveness of the warning reaching the population, those at greatest risk may or may not receive the warning and take precautionary measures. NOAA weather radio transmitters are located in Livingston and Mammoth, and those with specially built receivers can be alerted to weather hazards rapidly. The numerous campgrounds in the National Forests become particularly vulnerable populations if the warnings are not received. Depending on the significance of the storm, much of the population can be at risk if they do not take appropriate action.

Impact of Future Development

Future development will likely have little effect on the vulnerability to severe thunderstorms and tornadoes. The risk is assumed to uniform countywide, and therefore, the location of development does not increase or reduce the risk necessarily. Development and population growth may in fact improve the television and radio technology available to residents, and therefore, improve the warning capabilities.

Data Limitations

Severe thunderstorms and tornadoes can be such isolated events that the vulnerability to a particular area can be hard to determine. Weather data is often limited by the observations taken, and severe thunderstorm and tornado events are only recorded if reported to the National Weather Service. An in-depth study specific to Park County would need to be conducted to further develop this hazard profile. Historic lightning data may also pinpoint the areas that receive the most thunderstorms.

TERRORISM, CIVIL UNREST, and VIOLENCE

Description

Terrorism, civil unrest, and violence are human caused hazards that are intentional and often planned. Terrorism, both domestic and international, is a violent act done to try and influence government or the population of some political or social objective. Terrorist acts can come in many recognized forms or may be more subtle using untraditional methods. The primary recognized forms of terrorism are chemical, explosive, biological, radiological, and cyber.

Chemical terrorism is the use of chemical agents to poison, kill, or incapacitate the population. Chemical agents can be broke into five different categories: nerve agents, vesicants, cyanide, pulmonary agents, and incapacitating agents. Known nerve agents include tabun, sarin, soman, GF, and VX and can cause a variety of conditions affecting the central nervous system either through vapor or liquid form. Vesicants cause blisters on the skin and can damage eyes, airways, and other tissues and organs. Vesicant agents include sulfur mustard, Lewisite, and phosgene oxime. Cyanides can be in solid salt or volatile liquid format, or when combined with acid, a vapor or gas. Their absorption can cause everything from nausea to death, depending on the amount absorbed. Pulmonary agents such as phosgene and perfluroroisobutylene cause pulmonary edema usually hours after exposure. Incapacitating agents produce reversible disturbances with the central nervous system and cognitive abilities and include the agent BZ.[43]

Terrorism using explosive and incendiary devices includes bombs and any other technique that creates an explosive, destructive effect. Bombs can take many forms from a car bomb to a mail bomb to any suspicious package. They can be remotely detonated using a variety of devices or directly detonated in the case of a suicide bomb.

Bioterrorism is the use of biological agents to infect the population or animals with disease. The agents/diseases that the Centers for Disease Control and Prevention consider the highest priority due to their threat to the population and national security include anthrax, botulism, plague, smallpox, tularemia, and viral hemorrhagic fevers.[44] Bioterrorism could also be used against our livestock population and agricultural plants. The following are select animal diseases identified by the USDA as a severe threat to livestock and human health: Avian Influenza, Exotic Newcastle Disease, Nipah, Hendra, Eastern Equine Encephalitis, Venezuelan Equine Encephalomyelitis, Foot and Mouth Disease, Rift Valley Fever, Rinderpest, African Swine Fever, and Classical Swine Fever. Those plant diseases identified by the USDA as a severe threat to plants are: Soybean Rust, Southern Bacteria Wilt, Plum Pox, Downy Mildew of Corn, Brown Stripe Downey Mildew of Maize, Potato Wart, Bacterial Leaf Streak of Rice, Citrus Greening, and Pierce's Disease.[45]

Radiological terrorism involves the use of radiological dispersal devices or nuclear facilities to attack the population. Exposure to radiation can cause radiation sickness, long-term illness, and even death. Terrorism experts fear the use of explosive and radiological devices in the form of a "dirty bomb" to

[43] Sidell, Frederick R., M.D. Chemical Agent Terrorism. http://www.nbc-med.org/SiteContent/MedRef/OnlineRef/Other/chagter.html.
[44] Centers for Disease Control and Prevention, http://www.cdc.gov/.
[45] US Government Accountability Office. Homeland Security: Much Is Being Done to Protect Agriculture from a Terrorist Attack, but Important Challenges Remain. March 2005.

attack the population. As with chemical and biological events, radiological incidents present contamination challenges for first responders.

Cyberterrorism is the attack or hijack of the information technology infrastructure that is critical to the US economy through financial networks, government systems, mass media, or other systems. Any cyber attack that creates national unrest or instability would be considered cyberterrorism.

Civil unrest and violence typically occur on a smaller scale when large groups, organizations, or distraught individuals take action with potentially disastrous or disruptive results. Civil unrest can be the product of another event that creates panic in the community. Violence can be small scale, such as domestic violence, or larger and require significant government response, as is profiled in this plan.

Montana has traditionally attracted activist/extremist individuals and groups because of its low population and large geographic area. Groups active in Montana vary from white supremacists to single issue groups, such as environmental extremists. These groups are attracted to the state and many of them view Montana as their "home" or safe haven. Because of these views, they commit their illegal activities outside of the state. An example of this would be the Unabomber, Ted Kaczynski. Kaczynski advocated the destruction of technology and the protection of the environment. The Unabomber was responsible for sixteen bombings and three deaths around the United States.

Another example, *The World Church of the Creator,* which is a white supremacist group with a national following, advocates a "Racial Holy War" against minorities. This group has their national meeting in Superior, Montana once a year. Members of this group have been responsible for numerous homicides in the United States.

Groups such as the Phineas Priesthood of Spokane, WA have used western Montana as a place to hide. The anti-government group, the Freemen, conducted an eighty-one day standoff with law enforcement in eastern Montana. At the conclusion it was determined they were a "refuge" for individuals around the country involved in criminal anti-government activity. Several of these individuals had spoken about military type action against the current government. Many other organizations besides these that have the potential to use violence exist in parts of Montana and across the country.

Recently, the National Alliance, the largest neo-Nazi organization in the United States, has conducted leafleting campaigns in Southwest Montana and is trying to establish a presence in our communities. This organization has been tied to violent acts throughout the country.

Eco-terrorism is a growing domestic terrorism concern that has been noted in the western United States. The FBI defines eco-terrorism as the use or threatened use of violence of a criminal nature against innocent victims or property by an environmentally-oriented, subnational group for environmental-political reasons, or aimed at an audience beyond the target, often of a symbolic nature. Organizations identified by the FBI as having terrorist cells include the Animal Liberation Front (ALF) and the Earth Liberation Front (ELF). Although supporting organizations generally advocate peaceful demonstrations, the FBI estimates that the ALF/ELF have committed more than 600 criminal acts in the United States from 1996-2001, resulting in damages in excess of $43 million. The most destructive acts committed by the ALF/ELF involve arson. Many of these attacks have occurred in nearby states such as Washington, Oregon, Utah, Idaho, and Colorado[46]. One of the goals of these organizations is

[46] Testimony of James F. Jarboe, Domestic Terrorism Section Chief, Counterterrorism Division, FBI Before the House Resources Committee, Subcommittee on Forests and Forest Health. The Threat of Eco-Terrorism. February 12, 2002.

to preserve undeveloped lands. With the natural resources that exist in Park County and the potential for future development, this type of terrorism is considered the most likely in Park County.

History

Fortunately, Park County has not been the target of any major terrorist attacks. Some small local level events have required a government response. One such event, a small riot behind the Long Branch Saloon, required the fire department hose the area to disperse the crowd. Even this event, however, is considered rather small on the scale discussed here.

Probability

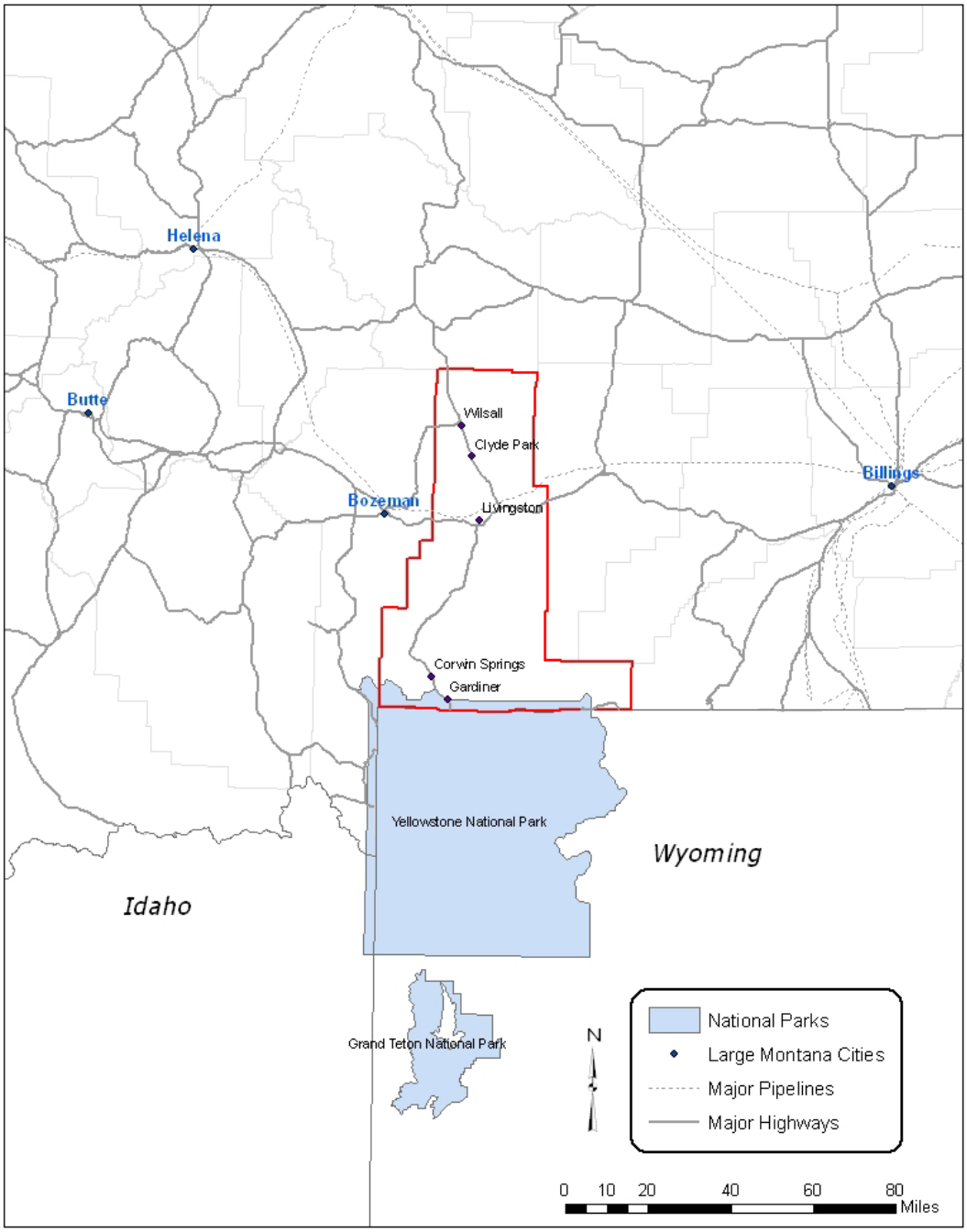
With very little experience and data locally on this hazard, a specific probability for future terrorism, civil unrest, and violence is hard to determine. Based on the historical record and the terrorism threat present for the area, the probability of a large scale terrorism, civil unrest, or violence event is considered low.

Mapping

The City of Livingston is the most populous part of Park County. This area, with close proximity to hazardous material facilities and government buildings, could be considered the area at greatest risk for terrorism. Domestic and international terrorism can be hard to predict, and therefore, specific targets are not easily identified.

National Parks are also considered potential terrorist targets, and therefore, Yellowstone National Park to the south puts Park County communities, particularly Gardiner, in close proximity this potential hazard area. Map 4.59 shows the largest communities with a higher terrorism risk near our county and Yellowstone National Park.

Map 4.59 Places Around Park County, Montana



Associated Hazards and Other Factors

Any hazard that can be "created" can be the result of terrorism, civil unrest, or intentional violence. For example, dam failure can be the result of a terrorist act of compromising the dam. Other examples include communicable disease, aviation, ground, and railroad accidents, hazardous materials release, utility failure, wildfire, and urban fire. All of these hazards could be the result of a terrorist act if intentionally triggered.

Vulnerability

Critical Facilities

Critical facilities in Park County would be considered to be at greatest risk from terrorism, civil unrest, and violence. Often, terrorists target facilities that are highly important for government services and community stability or are particularly vulnerable. Threat data is not specific enough to identify what facilities are most vulnerable, and therefore, all critical facilities are considered to have the same risk countywide. Those facilities with barriers, security, and other forms of protection could be considered to be at lower risk. Most facilities in Park County, however, do not have those protections.

Potential Losses

Residential structure losses are possible from terrorism, civil unrest, and violence but are not likely. Often the losses are at critical facilities or to the population. Looting, however, can be commonly found in association with these types of events. Therefore, this hazard places both the population and property at risk. Urban areas, places of public gathering, and important government or economic assets are generally going to be the areas of greatest risk. Should an event occur, the losses would likely be moderate.

Potential Population Impacts

The effects of terrorism, civil unrest, and violence are usually felt by the population. The greatest risk is to human lives during times of unrest. Terrorists typically try to make a dramatic impact that will generate media interest. Attacking the population through a large loss of life is a common tactic. Therefore, the greatest vulnerability from terrorism is to human life and the economy.

Impact of Future Development

Development should have little to no impact on the terrorism, civil unrest, and violence threat. The exception would be the increase in population and the associated increase of potential losses to life and property within the county. With larger communities around, however, development should have little effect in this regard. Given the goals of eco-terrorists, however, future development could serve as the basis for an event over controversial development.

Data Limitations

Since terrorism, civil unrest, and violence are such isolated events and little history exists in Park County, the probability and potential losses are difficult to quantify. Therefore, generalities have been made to estimate where potential losses could be. Site specific surveys would allow for an analysis of weaknesses of critical facilities, infrastructure, and vulnerable populations to terrorism, civil unrest, and violent incidents.

URBAN FIRE

Description

Although structure fires are usually individual disasters and not community-wide ones, the potential exists for widespread structure fires that displace several businesses or families. Urban blocks, commercial structures, and apartment buildings are especially vulnerable. Livingston and Gardiner are the communities in Park County with dense downtown areas that are vulnerable to this hazard. Clyde Park, although not particularly dense, has primarily older wood construction and is also vulnerable. An urban fire that rages uncontrollably despite firefighting efforts and burns a large portion of a downtown area could have significant economic impacts. Large fires of this nature have also been known to require significant community resources if lives are lost.

Some downtown buildings have been retrofitted with sprinklers while others have not. Other older structures in the county such as the buildings at Chico Hot Springs Resort also threaten to be large fire hazards. Businesses with special inventory, such as Golden Ratio, south of Emigrant, could also potentially have large fires. Newer resort areas, such as the Crazy Mountain Ranch, still present fire hazards but fortunately have been mitigated significantly through the installation of sprinkler systems.

History

A history of major structure fires in Park County was compiled based on fire department records and can be found in Table 4.60.

Table 4.60 Large Structure Fires in Park County, Montana[47]

Date	Location
February 29, 1904	"Post Office Block" in Livingston was destroyed.
August 10, 1969	Grand Hotel Block in Livingston was destroyed. Damages were estimated at $1 million.
October 26, 1975	Cave Supper Club in downtown Livingston destroyed the city block.
July 14, 1979	A fire at the Chico Hot Springs Resort resulted in approximately $10,000 in damage.
April 1, 1980	Sumner's Warehouse Carpet and Supply fire caused approximately $110,000 in damages.
March 22, 1981	Calamity Jane's Gambling Parlour and Saloon in downtown Livingston destroyed that city block.
September 7, 1985	Arsonists destroyed the Livingston Middle School.
November 17, 1985	Gardiner High School was destroyed.
Spring 1995	A propane leak at Chico Hot Springs led to an explosion at the resort. Fortunately, due to the time of the explosion, no one was hurt.
April 2004	An underground liquid propane line at the Crazy Mountain Ranch caught fire, flashed, and continued to burn for two days until all of the propane burned off. Fortunately, no buildings were damages and losses were confined to just the underground tanks and the liquid to gas converter.

[47] Livingston Enterprise newspaper articles archived by the Park County Rural Fire District, April 2005.

Probability

Based on the limited historical record listed in Table 4.60, nine significant fires have occurred since 1969. Based on this history, a significant structure fire can be expected once every four years. In recent years, however, the area has experienced a lower frequency of significant fires either due to firefighting efforts, sprinkler mitigation, or a cycle of lower occurrence. Irregardless, the probability of a major urban fire is considered low.

Mapping

Mapping does not exist presently on the areas that would be considered the areas of highest risk, except to say that the downtown areas of Livingston, Gardiner, and Clyde Park are the most vulnerable.

Associated Hazards and Other Factors

Urban fires can be linked to other potential hazards. Depending on the location of the fire, hazardous materials could be released. The event may also be linked to terrorism if intentionally set to instill fear in the population or disrupt the economy. Although lightning does not fit into the definition of severe thunderstorms, lightning from any thunderstorm could spark a significant urban fire. Possibly the greatest factors that determine if the urban fire will be severe are the age and condition of the structure, weather conditions, sprinkler systems, if any, and the preparedness level of the fire department.

Vulnerability

Critical Facilities

Most critical facilities within the downtown areas of Livingston and Gardiner are sprinklered, and therefore, should not be affected by a large urban fire. Therefore, the risk to critical facilities is considered low.

Potential Losses

Fire losses are usually covered by insurance, but can result in negative economic impacts for the area. Economic losses could total into the thousands of dollars or more depending on the area affected. With insurance covering much of the structural losses, economic losses would be the most significant, non-population loss to the local community.

Potential Population Impacts

Depending on the time and location, a major urban fire could result in a loss of life either to firefighters or building occupants. The potential for this type of loss is difficult to determine due to advances in firefighter safety and the installation of sprinkler and alarm systems in commercial and apartment

structures. For the purposes of this plan, the population impacts are considered low. Should lives be lost, however, significant resources could be needed to manage the recovery.

Impact of Future Development

Most development is not occurring in the downtown urban areas. Therefore, future development should have little impact on the urban fire hazard unless additional dense, downtown areas are created.

Data Limitations

Assessing the risk from urban fires offers many limitations. Since such fires are rather infrequent, assessing the probability potential losses is particularly limited. A countywide, comprehensive database providing details of significant fires such as cause, damages, casualties, and other impacts would prove useful in assessing this hazard.

UTILITY OUTAGE

Description

Utility outages can be caused by almost any of the hazards described in this risk assessment, but they can also occur because of human error or equipment failures. Electric, gas, telephone, and water are all important services that could become problematic should a long term outage occur. Electricity is used to power many homes in Park County, to pump wells, and run heating systems, even if electricity is not the primary fuel source. Therefore, if electricity was lost for a long period of time, many residents could be without heat, water, and other appliances. Vulnerable populations needing powered medical equipment would be additionally threatened by a long term power outage. Natural gas is used as a heat source for many residents in the Livingston area. Should that utility be lost in the winter months, the concerns associated with extended cold could be significant. Telephone services are most critical for 911 communications, and the rapid dispatch of needed emergency services. Cell phones would also be lost if telephone service went down. Many of the larger communities in Park County have public water supplies. Should those services be lost, many citizens would be without water and possibly sewer services. Any of these disruptions can be handled in a short time frame, but can quickly become problematic in long term situations.

History

Park County has not had any significant utility outages that can be considered disastrous.

Probability

Due to the lack of major historical events, the probability of a major utility outage in Park County is considered low. As growth occurs, however, the ability of many of the utility systems to keep up with the increased demand may increase the probability of a long-term outage.

Mapping

Many of the public utility features in Park County have yet to be mapped and those that have been mapped are withheld for system security purposes. Mapping is maintained by the entity managing the utility.

Associated Hazards and Other Factors

Utility failures can be caused by many of the hazards described in these profiles. Anything from an earthquake to a terrorist event could cause utilities to fail. Events that utility systems are particularly vulnerable to include earthquakes, floods, severe thunderstorms, tornadoes, high winds, winter storms, wildfires, and dam breaks.

Vulnerability

Critical Facilities

Critical facilities are vulnerable to utility outages. Some critical facilities do have back-up generators in case of an electricity outage. These facilities include the Livingston City/County Complex which serves as an EOC during times of disaster and provides 911 services. Others, however, may have limited functionality following an event due to a utility failure.

Potential Losses

Utility failures typically do not impact structures directly. A long-term utility outage during extended cold could result in a large number of frozen water pipes inside homes and businesses. Most often, economic losses occur during long-term utility outages. These losses would be most felt by businesses that require electricity or water to operate.

Potential Population Impacts

Without services such as heated shelters, food, and drinking water, the population could suffer. Significant casualties would not be expected since these services could be available in a nearby community. If not, necessary sheltering and feeding provisions would be made to protect the population. Significant relocations of vulnerable populations and disruption of normal lifestyles would be expected.

Impact of Future Development

Future development is not expected to have significant impact on this hazard. Increased populations add to the challenges of managing a long term utility outage but would not increase the damages necessarily.

Data Limitations

Since long term utility outages are not a normal event for Park County, understanding the specific problems and concerns of this hazard are the greatest limitation. Studies of each of the critical facilities would allow for a more in-depth discussion of their vulnerabilities.

VOLCANO

Description

Active volcanoes are not known to be present in Park County, but past eruptions have affected the county and possibility of an eruption in nearby Yellowstone National Park is always present. The active volcanic areas in the Cascade Range such as Mount St. Helens, Mount Rainer, and Mount Hood are to the west of Park County and are within the reasonable range of ash fall with the usual upper atmospheric wind patterns. Theoretically, these volcanoes could deposit ash several inches thick over Park County and any large eruption could change the weather patterns experienced globally.

The Yellowstone Caldera, one of the world's largest active volcanic systems, has produced several giant volcanic eruptions in the past few million years, as well as many smaller eruptions and steam explosions. Although no eruptions of lava or volcanic ash have occurred for many thousands of years, future eruptions are likely. Over the next few hundred years, hazards will most likely be limited to ongoing geyser and hot-spring activity, occasional steam explosions, and moderate to large earthquakes. To better understand Yellowstone's volcano and earthquake hazards and to help protect the public, the U.S. Geological Survey, the University of Utah, and Yellowstone National Park formed the Yellowstone Volcano Observatory, which continuously monitors activity in the region.[48]

If a large caldera-forming eruption were to occur at Yellowstone, its effects would be worldwide. Thick ash deposits would bury vast areas of the United States, and injection of huge volumes of volcanic gases into the atmosphere could drastically affect global climate. Fortunately, the Yellowstone volcanic system shows no signs that it is headed toward such an eruption. The probability of a large caldera-forming eruption within the next few thousand years is exceedingly low. Any renewed volcanic activity at Yellowstone would most likely take the form of non-explosive lava eruptions. An eruption of lava could cause widespread havoc in the park, including fires and the loss of roads and facilities, but more distant areas such as Livingston would probably remain largely unaffected.[48]

History

In May 1980, the eruption of Mount St. Helens sent ash high into the atmosphere. Approximately a half an inch of ash fell across Park County. Historical studies have shown that ash from Glacier Peak 11,200 years ago and Mount Mazama 6,600 years ago also fell in Park County.[13]

The Yellowstone region has produced three exceedingly large volcanic eruptions in the past 2.1 million years. In each of these cataclysmic events, enormous volumes of magma erupted at the surface and into the atmosphere as mixtures of red-hot pumice, volcanic ash (small, jagged fragments of volcanic glass and rock), and gas that spread as pyroclastic ("fire-broken") flows in all directions. Rapid withdrawal of such large volumes of magma from the subsurface then caused the ground to collapse, swallowing overlying mountains and creating broad cauldron-shaped volcanic depressions called "calderas."[48]

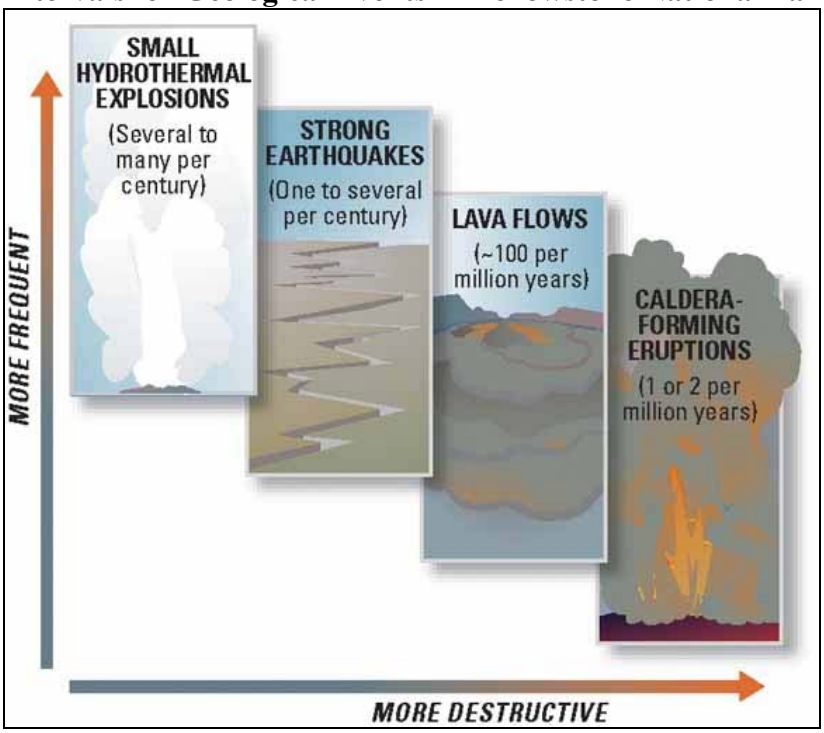
[48] US Geological Survey. Fact Sheet 2005-3024, Steam Explosions, Earthquakes, and Volcanic Eruptions – What's in Yellowstone's Future?. 2005.

Probability

Volcanic eruptions are rare events when considered in comparison to other hazards measured on the 100-year scale. The Montana Hazard/Vulnerability Analysis from 1987 estimates the return period of substantial volcanic ash fallout in Park County to generally once every 5,000-8,000 years.[13]

Scientists evaluate natural-hazard levels by combining their knowledge of the frequency and the severity of hazardous events. In the Yellowstone region, damaging hydrothermal explosions and earthquakes can occur several times a century. Lava flows and small volcanic eruptions occur only rarely - none in the past 70,000 years. Massive caldera-forming eruptions, though the most potentially devastating of Yellowstone's hazards, are extremely rare - only three have occurred in the past several million years. U.S. Geological Survey, University of Utah, and National Park Service scientists with the Yellowstone Volcano Observatory (YVO) see no evidence that another such cataclysmic eruption will occur at Yellowstone in the foreseeable future. Recurrence intervals of these events are neither regular nor predictable.[48] Figure 4.61 shows the probability of the various events that can occur in Yellowstone National Park.

Figure 4.61 USGS Graphic Depicting Recurrence Intervals for Geological Events in Yellowstone National Park[48]



Mapping

The areas affected by volcanic eruptions are dependent on the type of eruption and the prevailing wind direction. In an actual event, models would be used to predict the areas that would receive ash and other effects from the volcano. Therefore, mapping hazard areas would be broad generalizations and will not be completed here. The county is assumed to have the same risk countywide for a Cascade Range eruption and decreasing risk from south to north for a Yellowstone eruption.

Associated Hazards and Other Factors

Volcanoes, a geological feature, are closely related to earthquake activity. Often eruptions are preceded by earthquake activity as magma moves below the surface. The two events are usually closely linked and monitored. Other factors that become important during a volcanic eruption including wind speed, direction, and rainfall. The wind speed and direction will dictate when and where ash falls. Dry ash is manageable but when combined with rainfall, the ash becomes glue-like and much more difficult to control.

Vulnerability

Critical Facilities

All critical facilities are at risk from volcanic eruptions. The impact on the facilities will depend on the amount of ash that falls and the ability to remove it. Significant amounts of ash have the potential to clog air systems and shut down facilities. Given enough wet, heavy ash, the potential exists for roofs to fail. Infrastructure exposed to the ash fall, such as power systems, could be brought down by the ash as well. The removal of ash from government facilities and infrastructure could potentially create costs beyond the community's capabilities. Therefore, all critical facilities and vulnerable populations are vulnerable to ash fall.

Potential Losses

During Mount St. Helens' 1980 eruption, the greatest costs came from the difficult task of removing volcanic ash. The greatest threat is not necessarily to people or residences but to property such as vehicles and equipment. The volcanic dust is corrosive to metals and without proper removal can certainly cause damages to public and private property. In a Yellowstone eruption, the potential for heavy, wet ash could threaten structures by collapsing roofs. The probability of an event of this magnitude is very low. The economy, particularly the tourist economy, could be severely affected should an eruption occur or be imminent.

Potential Population Impacts

Light ash fall does not significantly impact the population if those with respiratory sensitivities remain indoors. Ash fall conditions that exist for several days, however, could lead to significant health problems for many in Park County. The extremely rare major Yellowstone eruption could lead to deaths to those close to the Park from pyroclastic flows and extreme amounts of falling ash. The degree of population impacts will greatly vary depending on the type of event.

Impact of Future Development

Future development will have little to no effect on the volcano hazard. Any new development will be exposed to the volcano hazards of Park County and increase the population and property values at risk.

Data Limitations

Volcanic eruptions that affect Park County are so extremely rare that documenting the potential impacts and probability is very limited. Continued study of the Yellowstone caldera and other volcanic areas will hopefully allow scientists, and therefore emergency managers, to better understand this hazard.

WILDFIRE

Description

Wildland fires are a part of nature in the mountainous, forested areas and arid grasslands of Montana. Park County has both broad areas of National Forests and dry open fields. Forest fires can travel quickly through the crowns of trees or spread along the forest floor. Grass fires are common in non-irrigated fields and open areas scattered with sage brush and native grasses due to the arid climate during almost any season but winter. Both types of wildfires are often aggravated by the exceptionally windy conditions in parts of the county.

A wildland fire can be categorized as either an uncontrolled fire in a forested/heavily vegetated area or in a grass/brush area. Both types of wildfires have the potential to destroy structures and natural resources while producing heavy amounts of smoke. Wildfires can be caused by any flame source but are most often triggered by lightning, human carelessness, arson, or train sparks. Once triggered, the ambient conditions dictate whether the fire will spread or not. Moist, cool, calm conditions or low fuels will suppress the fire, whereas dry, warm, windy conditions or heavy fuels will contribute to fire spread. The natural environment has evolved to live with fire. New growth occurs in a matter of a few years and some species require fire to grow.

Problems with wildfire occur when combined with the human environment. People and structures near wildfires are threatened unless adequately protect through evacuation or mitigation. Most structures are flammable, and therefore, are threatened when wildfire approaches. In addition, a significant loss of life could occur with residents who do not evacuate, firefighters, and others who are in the wildfire area. Infrastructure such as electric transmission lines, fuel tanks, and radio transmission towers are not often equipped to withstand the heat from a wildfire. Timber resources, animal habitats, and waterways can all be damaged leading to negative economic and environmental impacts. The area where human development meets undeveloped, vegetative lands is called the wildland/urban interface (WUI).

Park County is regularly threatened by wildfires because of the terrain, climate conditions, and fuels present. Park County has a large area of government owned lands, national forests in particular. Parts of the Bozeman, Livingston, Gardiner, and Big Timber Ranger Districts of the Gallatin National Forest, the Musselshell Ranger District of the Lewis and Clark National Forest, the Beartooth Ranger District of the Custer National Forest, and Yellowstone National Park are within the Park County borders. The US Bureau of Land Management manages many parcels of land within the county as well.

Fuels in Park County range from dense timber stands in varying terrain to native grasslands. Douglas fir, lodgepole pine, Engelmann spruce, sagebrush, rough fescue, and other grasses make up many of the wildland fuels in the county. Periods of drought, disease, insect infestations, and low fire activity or mitigation may all lead to an increase in hazardous fuels.

History

Park County has a long history of wildfires from small to large. Some have caused damages and others have not. The extent of damages often depend on the proximity to the human interface, fire spread rates, and the effectiveness of suppression and mitigation measures. The history of wildfires

can be difficult to compile because the various firefighting entities involved and a variety of recordkeeping measures over the years. The following events have been complied based on fire department records, firefighters' memories, a National Forest database, and other miscellaneous sources.

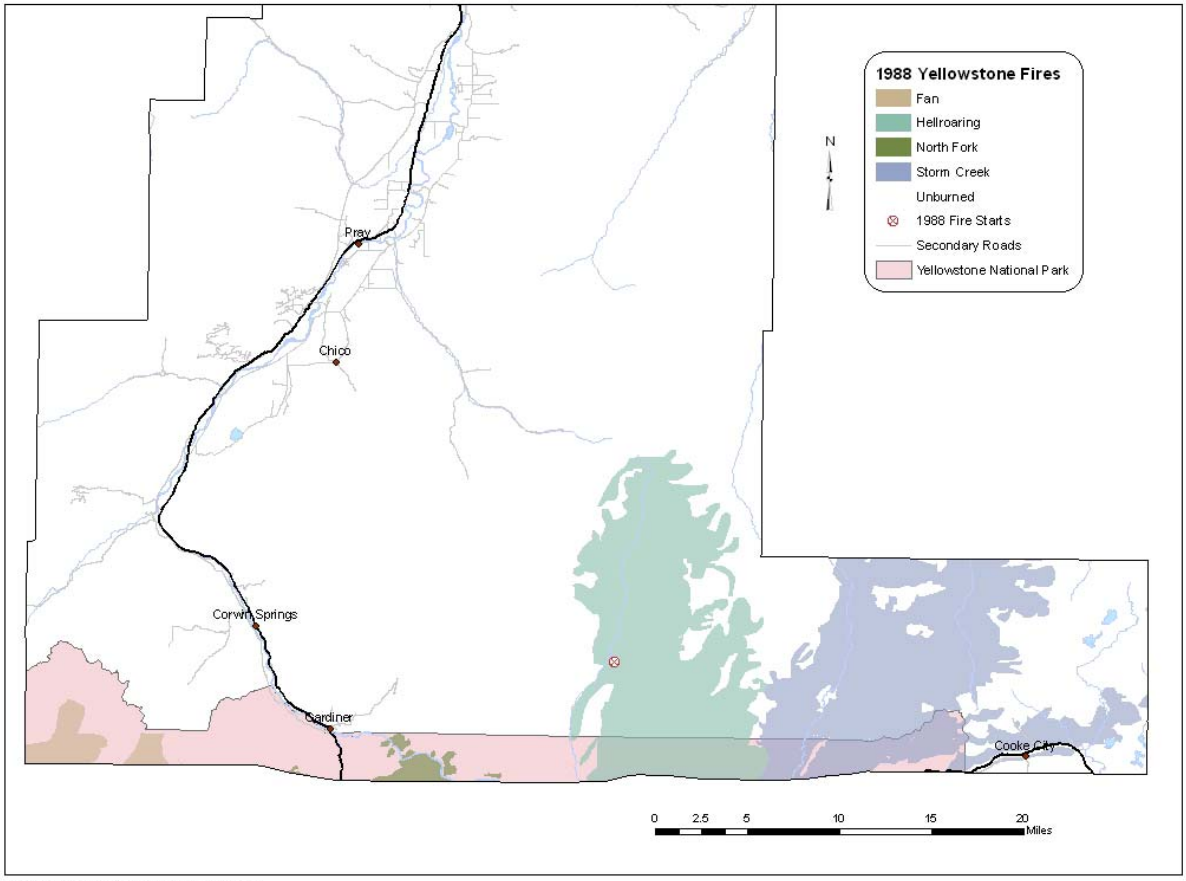
Historical Events:

1983. In April 1983, a large grass fire burned west of Livingston and south of Interstate 90. The Wan-I-Gan Fire near Emigrant that year destroyed 6 cabins.

July 1985. A lightning sparked fire at the base of Sheep Mountain threatened 5 homes and burned 1,000 acres.

1988. The Greater Yellowstone Fires of 1988, including some areas extending into Park County as shown in Map 4.62, covered 2.3 million acres, employed an estimated 25,000 firefighters, and cost nearly $120 million for fire suppression. Park County Resolution #274, issued on September 6, 1988, orders the evacuation of Cooke City and Silver Gate. One firefighter and one pilot were killed and structure losses were estimated at $3 million, mostly within Yellowstone National Park.[49] The Hellroaring and Storm Creek Fires were the largest ones to go through Park County.

Map 4.62. 1988 Wildfires in Park County



Data Source: National Park Service

[49] Yellowstone Park Net, http://www.yellowstoneparknet.com/history/fires.php.

1991. The Thompson Creek Fire, started on July 16, 1991, threatened two youth church camps. Two hundred-fifty campers were evacuated and sheltered in Livingston. The Area Creek region also experienced a fire from July 31 through August 1. On August 7, a railroad sparked fire quickly spread between Billman and Fleshman Creeks. Six homes were threatened.

1994. 1994 was a busy year for fires in Park County. The Deckard Flats Fire, Smith Creek Fire, Wineglass Fire, and Yak Fire were the largest fires. The Smith Creek Fire burned in a subdivision, but no structures were lost. Fires also burned in Paradise Valley in August including the Dry Creek Fire (40 acres), Eightmile Creek Fire (33 acres), and South Glastonbury Fire (30-50 acres).

1996. The Trowbridge Fire burned on Livingston Peak. September and October notable grass fires were sparked along Interstate 90. The Wineglass Fire on October 11, 1996 injured two people.

August 1999. The Six Mile fire in Paradise Valley, 3 miles east of Dailey Lake burned 1,100 acres.

2000. During this particularly severe fire season for Montana, the only large fire in Park County was one that burned in the north Crazy Mountains but did not threaten structures or infrastructure.

August 2001. Lightning ignited the Fridley Fire on August 19 near Fridley Creek in the Gallatin National Forest. Park County Resolution #727, issued on August 20, 2001, orders evacuations of threatened areas. The fire doubled in size on August 22 and displayed "extreme" behavior on August 23 when high winds caused it to double in size again. Then on August 25, 2001, Park County Resolution #728 closes roads near the Fridley Fire. Montana Executive Order 20-01, issued on August 25, 2001, declares a state of emergency in Park County and other locations across the state and mobilizes state resources and the National Guard to fight the wildfires. On Wednesday, August 29, the fire threatened a privately owned cabin southwest of Emigrant on the fire's southeast edge. The cabin was on a ridge top, making it difficult to protect. On August 31, three members of a firefighting helicopter crew were killed on a maintenance flight when a bucket line tangled with a rotor causing the helicopter to crash three miles south of Emigrant. The Fridley Fire was contained on September 13, 2001. In all, 26,373 acres burned from this fire and firefighting costs totaled over $11 million with 1,261 personnel, 50 pieces of heavy equipment, and 14 helicopters used. Fortunately, no structures were lost.[50]

A ball of flames rolls skyward as part of the Fridley Fire engulfs a stand of trees Monday, Aug. 20, 2001 between Fridley and Eightmile Creeks southwest of Livingston, Mont. Erik Petersen/Associated Press.[5]

[50] Pacific Biodiversity Institute, http://www.pacificbio.org/Projects/Fire2001/fridley.pdf.

Although the Fridley Fire was the largest in Park County in 2001, it was preceded by two other fires, the Hoppe and Monitor Fires, in late July and early August. The Monument Wilderness and Little Joe Fires also burned in Park County during August 2001. Both fires started on August 24 by lightning and were contained by September 3, 2001. The Monument Wilderness Fire started 10 miles northwest of Cooke City, burned 1,660 acres, with $417,000 in suppression costs. The Little Joe Fire was 20 miles east of Gardiner and burned 860 acres with suppression costs of $3 million.[41]

August 2003. The Rough Draw Fires started on August 10 by lightning. Park County Resolution #806, issued on August 14, 2003, declares an emergency to exist in Park County from wildfires. Then, the following resolution #807 on that same day closes roads near the Rough Draw Fire in Mission Creek on the northern boundary of the Absaroka-Beartooth Wilderness and the Slippery Fire in Cottonwood Creek near the Crazy Mountains. These fires, contained by September 5, 2003, were part of the larger Rough Draw Complex that burned over 3,000 acres and cost nearly $7 million. The Small Business Administration declared a disaster (#9W74) in Park County and offered loans to small business that suffered financial losses from the fires. Additionally, the Brundage Fire, started on August 15, by lightning, burned 3,200 acres in all. This fire, although ultimately larger than the Rough Draw Complex, was in a more remote part of the county and did not require as many resources.

The largest fires and costliest fires based on a Gallatin National Forest historical fire database[51] can be found in Tables 4.63 and 4.64 and the map of the costliest fires can be found on Map 4.65.

Table 4.63 Largest Wildland Fires By Acreage Burned for Park County, Montana

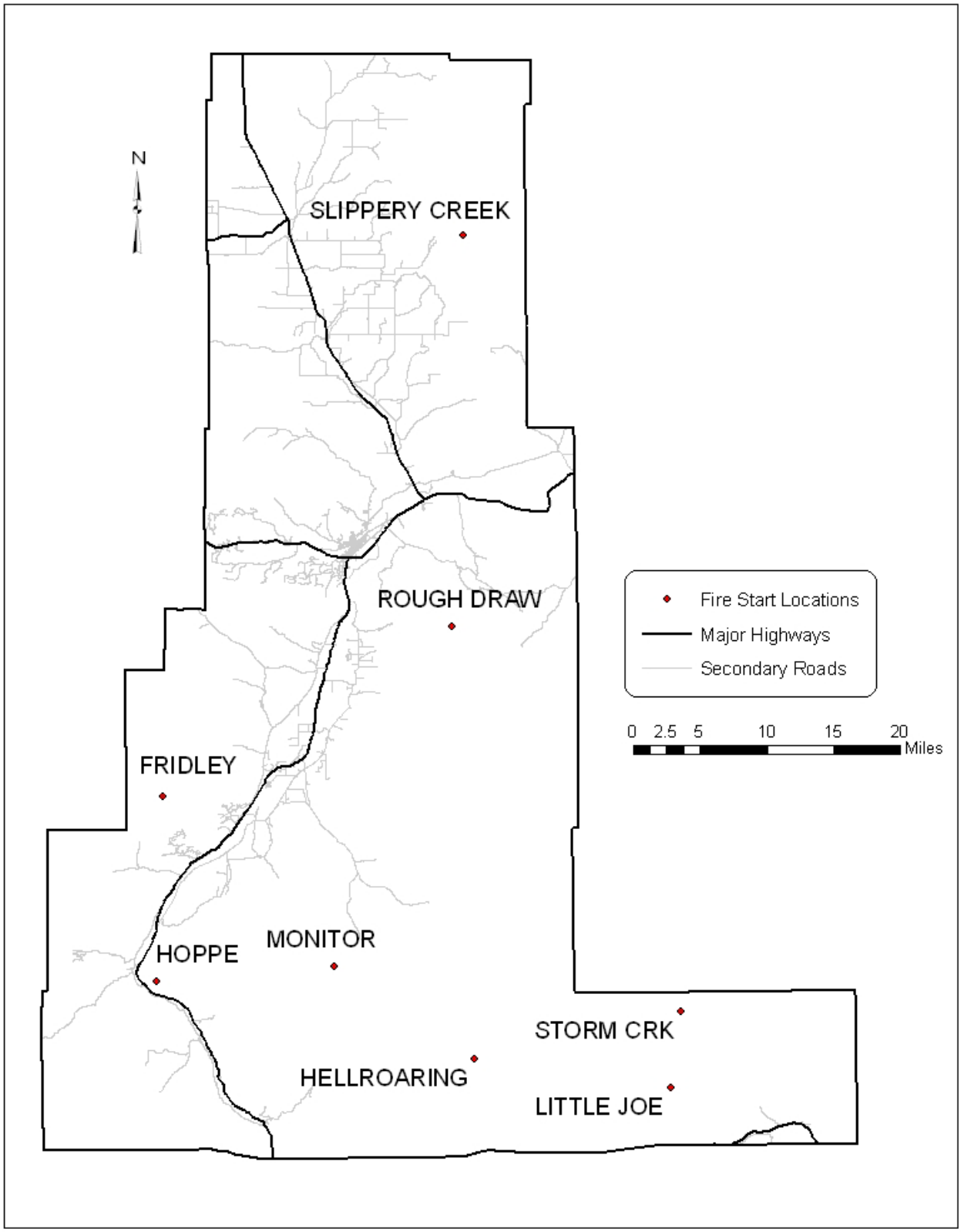
Name	Start Date	Acres Burned	Cause
Storm Creek	June 14, 1988	107,347 acres	Miscellaneous cause
Hellroaring	August 15, 1988	81,890 acres	Campfire cause
Fridley	August 19, 2001	26,873 acres	Lightning cause
Thompson Creek	July 16, 1991	7,746 acres	Lightning cause
Brundage	August 15, 2003	3,200 acres	Lightning cause
Deckard Flats	September 1, 1994	2,200 acres	Lightning cause
Slippery Creek	August 11, 2003	1,072 acres	Lightning cause
Rough Draw	August 8, 2003	1,029 acres	Lightning cause
Horseshoe Basin	July 18, 1953	1,007 acres	Lightning cause

Table 4.64 Costliest Wildland Fires in Park County, Montana

Name	Start Date	Cost	Acres Burned	Cause
Fridley	August 19, 2001	$12,500,000	26,873 acres	Lightning cause
Storm Creek	June 14, 1988	$8,700,000	107,347 acres	Miscellaneous cause
Hellroaring	August 15, 1988	$4,700,000	81,890 acres	Campfire cause
Little Joe	August 25, 2001	$4,200,000	860 acres	Miscellaneous cause
Slippery Creek	August 11, 2003	$3,400,704	1,072 acres	Lightning cause
Rough Draw	August 8, 2003	$3,264,295	1,029 acres	Lightning cause
Hoppe	July 27, 2001	$1,650,000	550 acres	Lightning cause
Monitor	August 6, 2001	$1,500,000	420 acres	Lightning cause

[51] Gallatin National Forest, Historical Fire Starts GIS Data, via Park County Rural Fire Department, 2005.

Map 4.65 Costliest Wildland Fires in Park County, Montana



Data Source: Gallatin National Forest, 2005

Probability

A study by the Montana Department of Natural Resources and Conservation in 1997 reports that approximately 80-100 fire starts per year occur in Park County. About 35-40% of those fire starts occur on US Forest Service (USFS) land and 60-65% occur on county protected lands. On the USFS lands, approximately 50% are natural and 50% man made, but on county lands, approximately 85% are man made and 15% are natural with debris/field burning, trains, and campfires being top three human caused ignition sources. This same study also found that a belt running from southwest to northeast through the Paradise Valley, Gardiner, and the Wineglass areas have the highest concentration of lightning strikes in the county.[52]

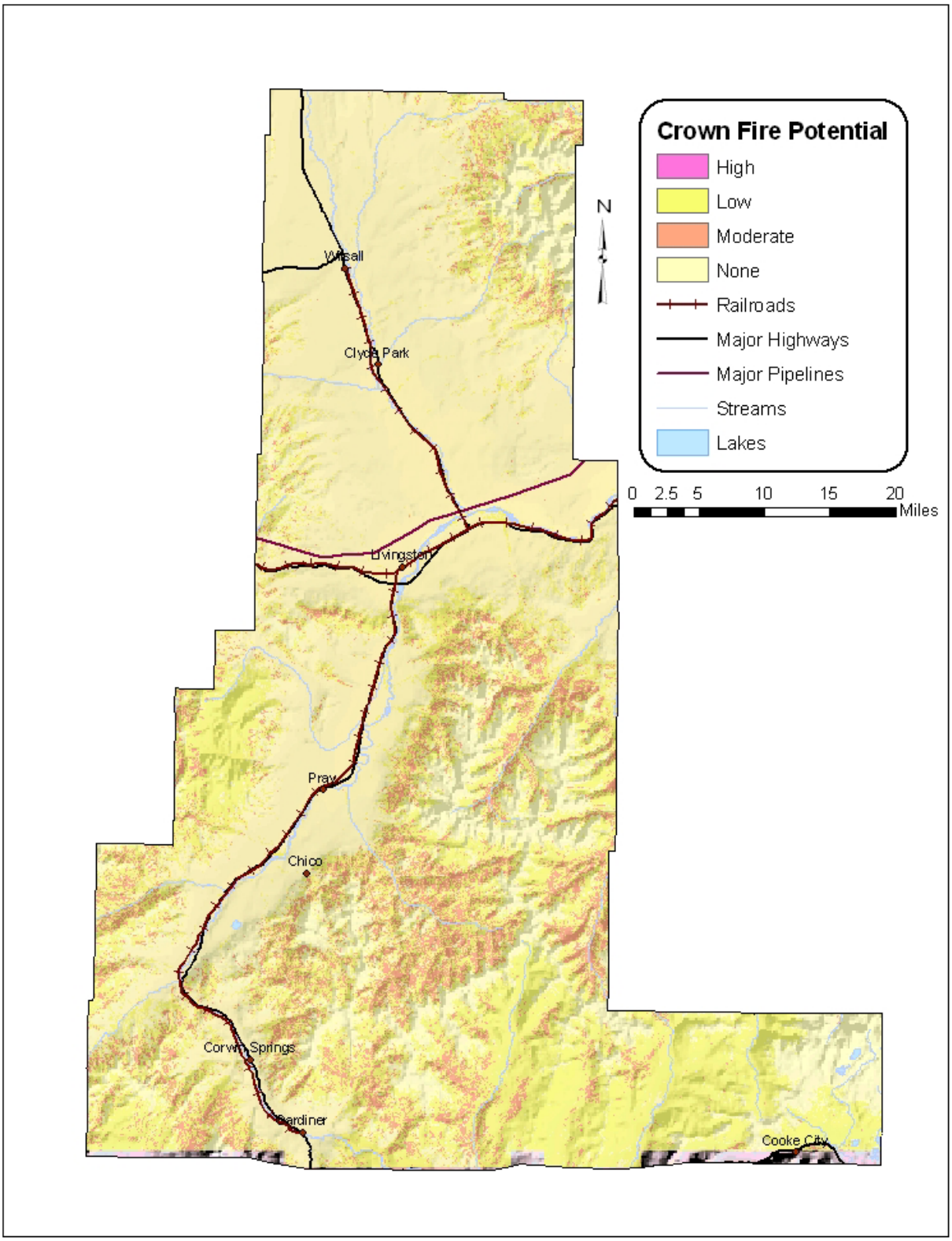
Gallatin National Forest data demonstrates at least 628 fire starts have occurred in Park County since 1940. This data only shows starts on national forests and does not account for starts on private lands, such as railroad fires. Based on the USFS data, national forests within Park County average 9.7 starts/year (628 starts/65 years) and 378 acres/start (237,350 acres/628 starts). The Park County Rural Fire Department estimates about 20 fires are started by the railroad each year.

Mapping

Map 4.66 shows the crown fire potential in areas identified by the US Forest Service. The US Forest Service has found that the potential for damaging wildfires is most directly related to the crown fire potential. Therefore, the map shows the estimated risk for areas within the County. This mapping was primarily done for Forest Service areas, and therefore, other privately owned parts of the County may be additionally threatened and not mapped. Map 4.67 shows the historical fire starts by cause as documented in the Gallatin National Forest database.

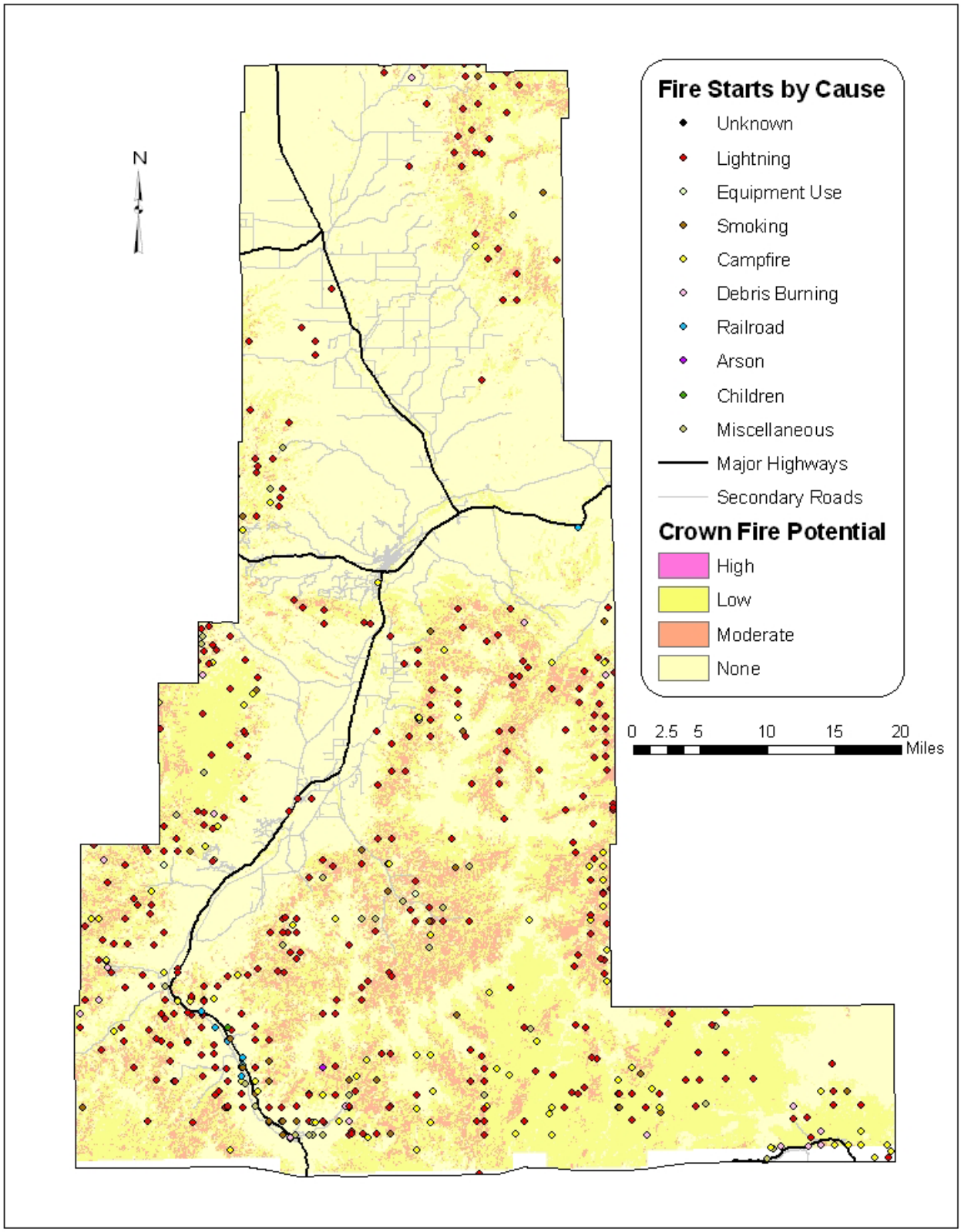
[52] Park County Rural and Wildland Fire Management Plan, DNRC, Bozeman Unit Office, 1997.

Map 4.66 Crown Fire Potential in Park County, Montana



Data Source: Northern Region Cohesive Strategy Team, 2002

Map 4.67 National Forest Fire Starts By Cause in Park County, Montana



Data Source: Gallatin National Forest, 2005
Northern Region Cohesive Strategy Team, 2002

Associated Hazards and Other Factors

As if a raging wildfire isn't bad enough, the charred ground and thick smoke plumes it produces can create other hazards. The heavy smoke produced by a wildfire can cause unhealthy air conditions that may affect those with respiratory problems and otherwise healthy people. The air conditions are often monitored and alerts may be issued. Smoky conditions can also lead to poor visibility and an increased probability of ground transportation or aircraft accidents. Besides air pollution, water pollution may also occur during and after a wildfire. Many watersheds in wildland areas serve as the public water supplies for area communities. Should a significant wildfire pass through the area, pollution of the watershed can occur. With vegetation removed and the ground seared from a wildfire, the area also becomes more prone to flash floods and landslides because of the ground's reduced ability to hold water.

Vulnerability

Critical Facilities

Critical facilities set in wildland areas can be particularly problematic during fires. Fortunately, none of the critical facilities identified for Park County interface with the wildlands. Electric and communications infrastructure, however, including the major regional electric transmission lines and the Tom Miner microwave sites, can be found in forested, wildland areas. This infrastructure is highly vulnerable to wildland fire without mitigation.

Potential Losses

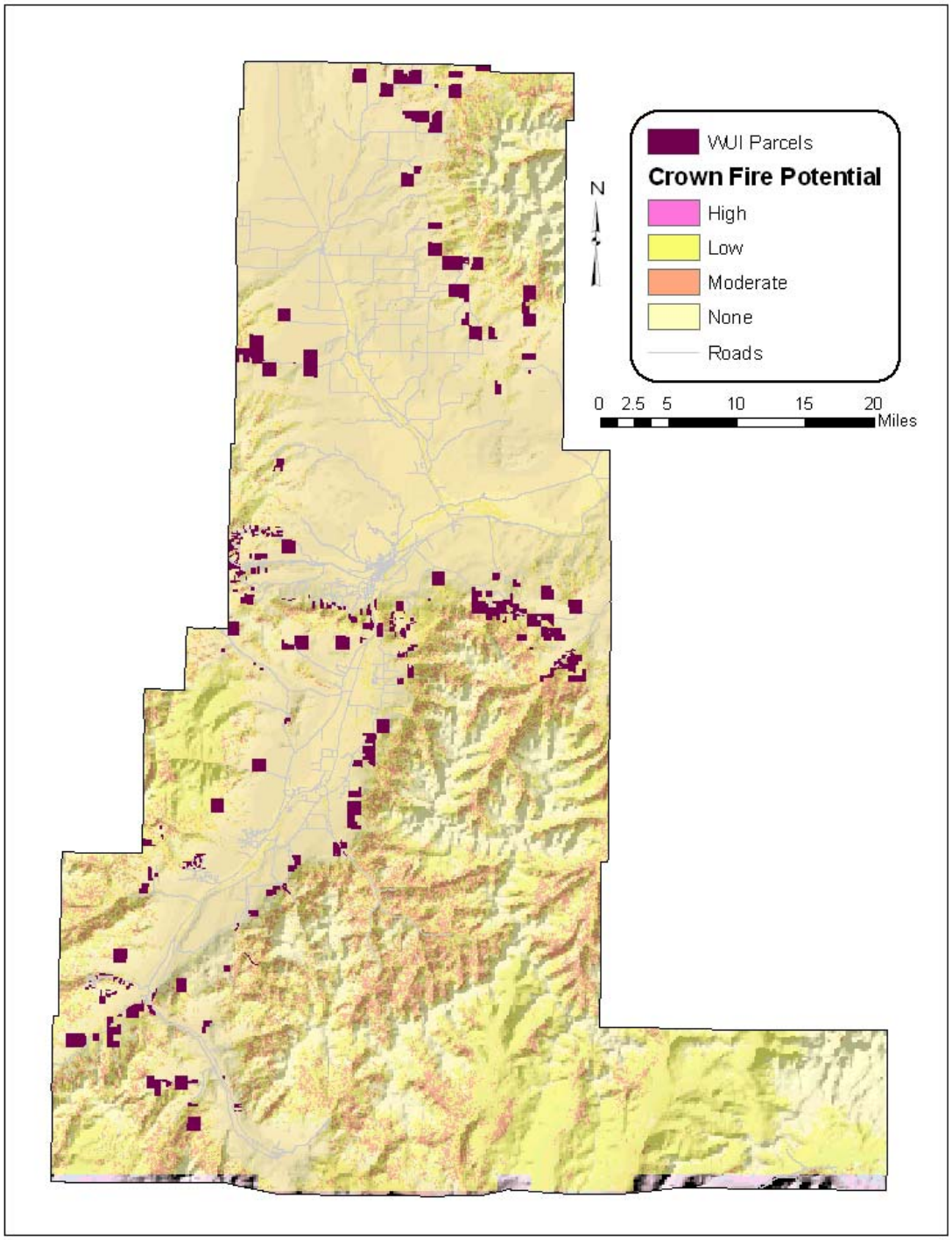
Wildfires have the greatest potential to substantially burn National Forests and National Parks acreage, however, private residences become threatened when the fire enters the wildland/urban interface. Park County has many wildland/urban interface areas that may be threatened should a wildfire encroach. Using the crown fire potential map in conjunction with parcel and structure data, an estimate of the number of structures in the interface was derived. Approximately 525 structures are located in the wildland/urban interface (WUI). This figure is a planning estimate based on available GIS data. The Community Wildfire Protection Plan, once completed, will have a more accurate assessment of the hazard areas and potential losses from this hazard. Using the state tax assessment data, the total value of these structures is estimated at $62,338,779. As Map 4.68 shows, the WUI areas are widespread across the county. The only WUI areas not shown on Map 4.68 are those sections that do not have parcel data (the southeast section of the county). An estimated 100 structures are within the WUI for that area in places like Cooke City, Silver Gate, and along the Boulder River.

A wildfire damage factor is rather difficult to determine because any actual losses will be highly dependent on the fire characteristics and its location. Not all areas will be affected by one wildfire. Losses in the area of the WUI fire, however, could have a high loss rate. Given the assumption that 15% of the structures in the total WUI could be lost in a probable wildfire, the structure losses from that fire would roughly total $9.4 million dollars with 79 structures affected.

Although the primary concern is to structures and the interface residents, most of the costs associated with fires, come from firefighting efforts in suppression costs. Additional losses to natural resources, water supplies, air quality, and the economy are also typically found. As past events have also shown,

infrastructure such as power transmission lines can be threatened. Wildfires can also have a significant impact on the regional economy with the loss of timber, natural resources, recreational opportunities, and tourism, all of which are of particular importance in Park County.

Map 4.68 Parcels with Taxable Structures Estimated in the Wildland/Urban Interface



Data Source: Northern Region Cohesive Strategy Team, 2002
Montana Department of Revenue Computer Assisted Mass Appraisal (CAMA) Database 2004

Potential Population Impacts

Using the estimate of 79 structures affected in a major wildfire from the Potential Losses section, roughly 150 people would live in the affected area (79 structures x 1.9 people/structure). In many cases, residents can be evacuated before the fire moves into their area. Some residents, however, may choose to remain in the evacuated area or a rapidly spreading fire may not allow enough time for a formal evacuation. Firefighters can also be particularly threatened during wildfires. Advances in firefighter safety and technology have improved firefighting efforts, however, the potential for loss of life and injuries still exists. For these reasons, the impact on the population can be considered moderate.

Impact of Future Development

The wildland/urban interface is a very popular place to live as national trends show. More and more homes are being placed in this interface, particularly in Montana, and Park County is no exception. Development in the hazard areas has increased in recent years and has amplified the vulnerabilities in the unincorporated parts of Park County significantly. Regulating growth in these areas is a delicate balance between protecting private property rights and promoting public safety. The draft county growth policy recognizes the wildfire threat and emphasizes defensible space, inspection of new development, water supplies, fuels mapping, and Firewise type programs. These recommendations may be incorporated into the Park County Subdivision Regulations in the future. The Park County Fire Council is currently working toward revised fire regulations. The current regulations, dated June 1, 2004, requires the following:

- Subdivisions must be in a fire district.
- Subdivisions must be reviewed by the fire department for compliance with required fire protection and prevention measures.
- Major subdivisions (more than 5 lots) must provide a year-round self replenishing central water supply either on-site or within one mile with a minimum flow of 250 gpm for 2 hours.
- Minor subdivisions (5 lots or less) must have a water supply of at least 2,500 gallons per lot on site with an approved hydrant system, a developed water source with 250 gpm for 20 minutes within 2 miles (or less if in a high wildfire hazard area), or automatic sprinkler systems.
- High wildland fire areas are considered to be heads of draws, excessive slopes, dense forest growth, or other hazardous wildfire components, and the planning board may designate the homesite on a parcel in these areas to minimize the threat.
- Subdivision covenants in high wildland fire areas must recommend new lot owners contact the fire department or planning office for Firewise building and landscape practices.

Data Limitations

The wildland/urban interface can be defined in many ways to include areas of flammable grasses or steep slopes. For the purposes of this analysis, areas with the potential for crown fires defined the interface. A more detailed study, using field analysis techniques, would allow for better WUI and potential loss estimates. Fuels mapping would further define the areas at greatest risk. A comprehensive, countywide wildland fire digital historical database encompassing all firefighting agencies that includes data on start location, cause, area burned, suppression costs, and damages would prove highly beneficial in advancing the assessment of this hazard. A complete database of structures and water supplies in Park County would enhance this hazard profile as well. Park County is currently writing a Community Wildfire Protection Plan that will better outline the wildfire hazard.

WIND

Description

Park County, and Livingston in particular, is known for its wind. Strong winds regularly blow through the area, even when neighboring areas are experiencing near calm conditions. Besides the high winds that can occur with severe thunderstorms, as described in the severe thunderstorm and tornadoes hazard profile, high winds can also occur with strong pressure gradients and gusty frontal passages. Livingston's windy conditions are primarily due to the topographical features of the area.

The strongest winds from the south to west directions in Livingston can be described in terms of the topography. Figure 4.69 shows the topographical features of the area. During the winter, Yellowstone National Park gets very cold. As the air moves from the higher elevations into the valleys, it warms, accelerates, and gets funneled as it moves through the narrow Paradise Valley and constricts between the Wineglass Mountains and Livingston Peak. Like water in a hose, the constriction causes the air to move faster. Strong winds then rush through Livingston. As the winds from the west pass over the Gallatin Valley and Bozeman, the air piles up on the west side of the Bridger and Gallatin Mountain Ranges only being able to pass through at the lower elevations through Bozeman Pass which opens up to Livingston. The wind that does make it over the mountain ranges typically accelerates and rushes down the lee side of the mountains, creating strong surface winds throughout northern Park County.

Figure 4.69 Topography of the Livingston Area[53]

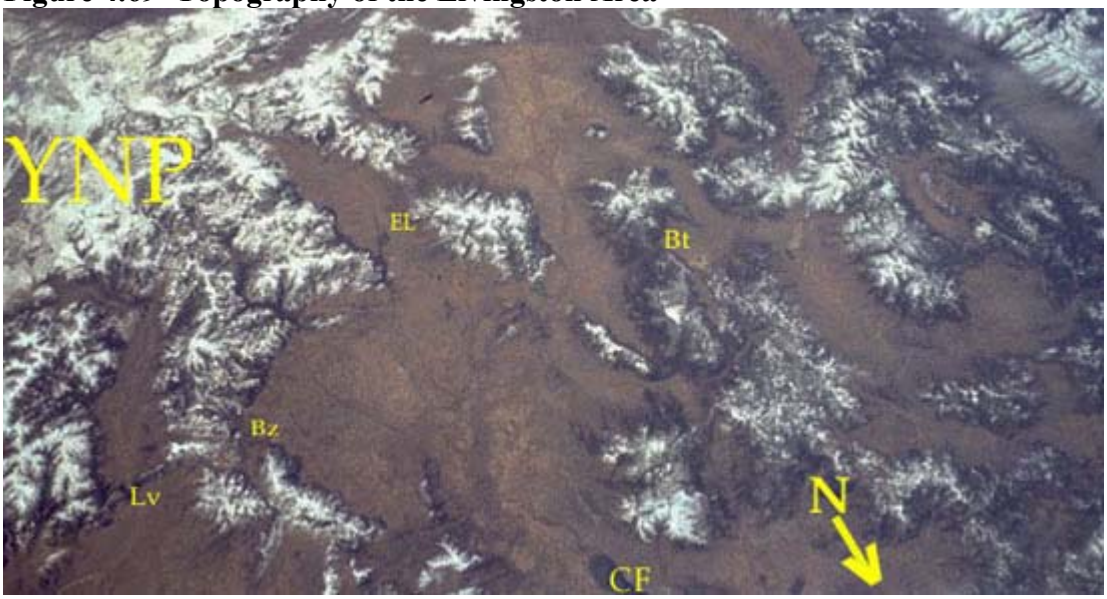


Photo courtesy of NASA and Rod Benson, Helena High School

YNP = Yellowstone National Park
Lv = Livingston
Bz = Bozeman
EL = Ennis Lake
CF = Southern Canyon Ferry Lake
Bt = Butte

[53] Benson, Rod, Helena High School, http://formontana.net/livingston.html.

Strong winds are so frequently over 30 mph in Park County that the National Weather Service increased their wind advisory and high wind warning thresholds for the county. A wind advisory is issued when sustained winds of at least 40 mph and gusts of 60 mph are expected for at least six hours. High wind warnings are issued when sustained winds of at least 50 mph are expected for an hour or more or wind gusts of 75 mph or greater are expected. In contrast, most locations in Montana start at 30 mph sustained for wind advisories and 40 mph sustained for high wind warnings.

History

Park County has a long history of high wind events. In a study conducted for the State of Montana's Hazard Assessment, Park County ranked third in the state for the most number of non-thunderstorm wind events over hurricane force (74 mph) with 22 recorded events over a 10 year period. The strongest non-thunderstorm wind events in the past ten years can be found in Table 4.70.

Table 4.70 Non-Thunderstorm Wind Events Greater than 80 mph in Park County, Montana

Date	Location	Speed	Additional Information
April 24, 1996	South of Grey Owl Fishing Access	100 mph	Wind speed estimated. Tree blown onto Highway 89.
December 4, 1996	Livingston	100 mph	Measured at Mission Field.
November 29, 1994	Livingston	92 mph	Several semi trucks blown off Interstate 90, hanger roof blown off at Mission Field, spotty power outages, Interstate 90 closed for the evening. Damages estimated at $500,000.
February 1, 1999	6 miles South of Livingston	92 mph	Sustained winds of 50 mph and gusts to 89 mph in Livingston. Several trees and power lines downed. 1,500 homes were without power for 2 hours.
November 3, 1993	Livingston	90 mph	Wind damage reported in Livingston.
January 30, 1997	Livingston	85 mph	Measured at Mission Field.
November 13, 1998	Livingston	85 mph	Measured at Mission Field.
January 9, 2000	Livingston	84 mph	Measured at Mission Field.
February 1, 2000	Livingston	84 mph	Measured at Mission Field. Winds sustained at 51 mph.
November 28, 1996	Livingston	81 mph	Measured at Mission Field.

Probability

Based on the ten year historical record, the probabilities in Table 4.71 can be estimated.

Table 4.71 Non-Thunderstorm Wind Probabilities Based on Historical Occurrence in Park County, Montana

Speed	Average Occurrences Per Year	Recurrence Interval
75 mph or greater (hurricane force)	2.2 events/year	5-6 month event
80 mph or greater	1 event/year	1 year event
90 mph or greater	0.5 events/year	2 year event
100 mph or greater	0.2 events/year	5 year event

According to the National Weather Service, November is historically the windiest month in Park County with winds from the southwest.

Mapping

All of Park County is considered to be at risk for high wind events. The most vulnerable areas, however, are in the Livingston area from south, southwest, and west winds and northern Park County from southwest and west winds. The base of the Crazy Mountains is known to be particularly windy.

Associated Hazards and Other Factors

High winds can become particularly problematic when combined with falling snow or snow on the ground. Blizzard conditions from blowing and drifting snow can develop with the onset of strong winds. History also shows that the strong winds on Interstate 90 can lead to ground transportation or railroad accidents and possibly a hazardous materials release.

Almost any other hazard can be aggravated by high winds. Wildfires and urban fires can spread more rapidly under high wind conditions. Drought conditions can be made worse by winds quickly evaporating ground moisture and causing soil erosion. Avalanches become more likely on wind loaded slopes. Aviation accidents are more likely to occur in windy conditions. Should a utility outage occur in the winter, home heat would be lost more quickly during high winds. Warm winds have even lead to more severe flooding by melting the snowpack quicker.

Vulnerability

Critical Facilities

All of the critical facilities in Park County are susceptible to high winds. The risk will be assumed to be the same countywide since high winds can strike anywhere. Given a history of power outages, the electrical infrastructure is assumed to have a slightly greater risk to high winds than other types of infrastructure. The airport also has a history of wind-related losses.

Potential Losses

With wind problems occurring regularly in Park County, most structures are designed to withstand high winds. Therefore, the potential losses to structures are limited. They can, however, occur during some of the most extreme events. More often, the greatest threat is to high profile vehicles. During particularly severe winds, trucks are diverted from the Interstate through Livingston. History has shown, based on National Weather Service records, that at least one incident over the past 12 years has caused $500,000 in damages. Based on this limited data, an annualized loss of $41,666 ($500,00 / 12 years) can be assumed.

Potential Population Impacts

Since Park County regularly has high wind events, most residents are prepared for and acclimated to windy weather. In most synoptic scale wind events, the National Weather Service is able to provide ample warning through their wind advisories and high wind warnings. The Montana Department of Transportation also regularly posts weather messages on Interstate message boards. The risk to the population, therefore, is considered low.

Impact of Future Development

Future development would only be threatened if structures were built without consideration for wind. Since Park County regularly has strong winds, development typically occurs with that consideration, and therefore, is not often threatened by wind events. Developers are not required, however, to adhere to any structural building codes for most residential structures, except for within the City of Livingston and its donut area. The City of Livingston does require tie downs for mobile home parks. The particularly windy area at the base of the Crazy Mountains currently has large ranches, but should development occur in this area, wind would be a notable hazard requiring consideration.

Data Limitations

Hourly wind data is regularly recorded at Mission Field in Livingston, but not in other parts of the county. Therefore, the ability to identify the areas most vulnerable to wind is limited. Park County is well known to have windy conditions, but because of the regular wind events, the losses from such events may not be well document except through private insurance records.

WINTER STORMS and EXTENDED COLD

Description

Snow storms and bitterly cold temperatures are common occurrences in Park County and generally do not cause any problems as residents are used to winter weather and are prepared for it. Snow falls regularly during all seasons, except summer, and roads become slippery quite often. Residents understand that this is part of living in Montana. Sometimes, however, blizzards can occur and overwhelm the ability to keep roads passable. Heavy snow and ice events, particularly late season events, have the potential to bring down power lines and trees. The extreme wind chills, often dropping below zero, may harm residents if unprotected outdoors or if heating mechanisms are disrupted. Table 4.73 lists the various National Weather Service winter weather warning criteria for Park County.

Table 4.73 NWS Winter Weather Warning Criteria

Warning Type	Criteria
Blizzard Warning	Heavy snow or blowing snow (visibility less than 1/4 of a mile) and sustained winds or frequent wind gusts of 35 mph or more are expected for a period of several hours.
Heavy Snow Warning	Snowfall of at least 6 inches in 12 hours or 8 inches in 24 hours is expected. In the mountains above 6000 feet, snowfall of at least 8 inches in 12 hours or 12 inches in 24 hours.
Winter Storm Warning	Heavy snow and windy conditions, not meeting the blizzard warning criteria, are imminent or have a very high probability of occurring. A winter storm warning indicates a decent chance that the event will pose a threat to life and/or property.
Winter Storm Watch	Blizzard conditions, heavy snow, significant freezing rain, and/or heavy sleet are possible but its occurrence, location, and/or timing are still uncertain. Winter storm watches are typically issued 12 to 48 hours before an event is expected to begin.
Winter Weather Advisory	Winter weather is imminent or has a very high probability of occurrence, but the expected hazard does not meet warning criteria. Conditions are expected to cause significant inconvenience and, if caution is not exercised, could lead to situations that may threaten life and/or property. Examples of winter weather advisory conditions include visibility 1/4 mile or less, an ice accumulation which makes surfaces hazardous, and/or snow of 2-5" in 12 hours.
Winter Storm Outlook	Alert the public of the potential for a significant winter storm, in a 48 hour or beyond time span.
Wind Chill Warning	Wind chill temperatures of -40ºF or colder and winds of 10 mph or greater are expected for 6 hours or more.
Wind Chill Advisory	Wind chill temperatures of -20ºF or colder and winds of 10 mph or greater are expected for 6 hours or more.

History

Table 4.73 shows the winter weather records from various reporting stations in Park County.

Table 4.73 Winter Weather Records for Park County, Montana[4]

Location	Period of Record	Low Temperature Record	Daily Snowfall Record
Wilsall, 8 miles ENE	1957-2004	-42°F, February 3, 1989	20 inches
Springdale	1951-2004	Not Applicable	18 inches
Livingston Airport	1948-2004	-41°F, December 24, 1983	16.5 inches
Livingston	1895-1981	-45°F, February 15, 1936	16 inches
Livingston, 12 miles S	1951-2004	-36°F, December 24, 1983	24 inches
Gardiner	1956-2004	-31°F, February 3, 1989	18.5 inches
Jardine	1951-1976	Not Applicable	28 inches
Yellowstone National Park, near Silver Gate	1948-1967	-51°F, January 12, 1963	20 inches
Cooke City, 2 miles W	1967-2004	-43°F, February 5, 1982	21 inches

Other notable events include late season snows such as May 8, 2002 when Wilsall received 17 inches of snow and Livingston received 9 inches and May 22, 2002 when Cooke City received 9 inches of snow.

Probability

The probability of winter storms each season is almost a certainty. The probability of an event that overwhelms the community capabilities, though, is harder to determine. To date, Park County has not had any winter weather events that have lead to a Presidential Disaster Declaration, but such an event is certainly possible and cannot be overlooked. Since significant winter weather is a common occurrence, the probability of a disastrous event is considered moderate.

Mapping

Across the county, Park County is vulnerable to winter weather. Therefore, the risk assumed to be the same countywide.

Associated Hazards and Other Factors

Winter storms and extended cold can be associated with many other hazards. In particular, ground transportation accidents. Interstate 90 and other roadways can become hazardous very quickly during winter storms. Such incidents normally involve passenger vehicles, however, an incident involving a commercial vehicle transporting hazardous materials or a vulnerable population such as a school bus is also possible. Any hazard that causes a utility outage, such as an earthquake, during an extended cold period would present sheltering and cold weather exposure challenges. When combined with wind, blizzard conditions can quickly result. Urban firefighting efforts may also be more challenging during extreme cold temperatures due to frozen water lines. Heavy snow can alleviate drought conditions and improve forest health, thus decreasing the wildfire threat, but in doing so can often increase the probability of avalanches and riverine flooding come springtime.

Vulnerability

Critical Facilities

All critical facilities are assumed to have the same vulnerability from winter storms and cold temperatures. Those facilities with back-up generators are better equipped to handle a winter storm situation should the power go out. Otherwise, all are designed to withstand winter storms but may not be able to provide heat if electricity service is lost.

Potential Losses

Snow in Park County generally does not cause the communities to shut down or disrupt activities. Occasionally, though, extreme winter weather conditions can cause problems. The most common incident in these conditions are motor vehicle accidents due to poor road conditions. These losses are usually covered by insurance. Losses to structures are usually minimal. Most structures are built to withstand reasonable snow loads in this region.

Potential Population Impacts

Since winter storms and cold spells typically do not cause major structural damage, the greatest threat to the population is the potential for utility failure during a cold spell. Although cold temperatures and snow are normal for Park County, extremes can exist that would go beyond the capabilities of the community to handle. Should the temperatures drop below -15 for several weeks or several feet of snow fall in a short period of time, the magnitude of frozen water pipes and sewer lines or impassable streets could result in disastrous conditions for many people. If power lines were to fail due to snow/ice load, winds, or any other complicating factor, the situation would be compounded. In the event power or other utilities were disrupted, many homes could be without heat or water. With temperatures frequently dropping below zero in a typical winter, an event where heating systems failed could send many residents to shelters for protection. Other residents may try to heat their homes through alternative measures, and thereby, increase the chance for structure fires or carbon monoxide poisoning.

Sheltering of community members would present significant logistical problems when maintained over a period of more than a day. Transportation, communication, energy (electric, natural gas, and vehicle fuels), shelter supplies, medical care, food availability and preparation, and sanitation issues all become exceedingly difficult to manage in extreme weather conditions. Local government resources could be quickly overwhelmed. Mutual aid and state aid might be hard to receive due to the regional impact of this kind of event.

Impact of Future Development

Future development should have little to no impact from winter storms and extended cold weather. The most significant challenge may be, as homes go up in more remote parts of the county, to access those residents should sheltering or emergency services be needed in an extreme event.

Data Limitations

Since major winter weather incidents occur frequently, but typically do not cause damages, the biggest data limitation is in understanding the magnitude of an event that begins to cause problems and the associated impacts that challenge the local government. Records outlining the winter weather conditions (snow depth, temperature, wind, snowfall rates, water content, and duration) and the problems (number of accidents, condition of roadways, and services needed) would increase the local understanding of this hazard.

Risk Assessment Summary

This risk assessment represents an approximate history and estimated vulnerabilities to the communities from the hazards identified. As with any assessment involving natural or man-made hazards, all potential events may not be represented here and an actual incident may occur in a vastly different way than described. This assessment, however, will be used, where possible, to minimize damages from these events in the future.

Every type of event is different, ranging from population to property to economic impacts. Incidents also have different probabilities and magnitudes even within hazards. For example, a small earthquake will be different than a large earthquake and a moderate flood will be different from both of those. In an attempt to rate hazards and prioritize mitigation activities, a summary of the impacts from an event is presented in Table 4.74. Some hazards have estimates of dollar losses and population impacted whereas others are more qualitatively assessed based on available information from the risk assessment process. For more information on these determinations, see the individual hazard profiles.

Table 4.74 Summary of Hazards for Park County, Montana

Hazard	Probability of Major Disaster	Property Impact	Population Impact	Economic Impact	Future Development Impact	Relative Overall Risk
Flooding	High	High $18.9M	Moderate	Moderate	High	High
Wildfire	High	High $9.4M	Moderate	Moderate	High	High
Earthquake	Moderate	High $82.6M	Moderate	High	Moderate	High
Hazardous Materials Release	High	Low	High	High	Low	High
Communicable Disease and Bioterrorism	Moderate	Low	High	High	Low	Moderate
Wind	Moderate	Moderate	Moderate	Low	Low	Moderate
Drought	High	Low	Low	High	Moderate	Moderate
Winter Storms and Extended Cold	Moderate	Low	High	Moderate	Low	Moderate
Utility Outage	Moderate	Low	High	Moderate	Low	Moderate
Severe Thunderstorms and Tornadoes	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Ground Transportation Accident	Moderate	Low	Moderate	Low	Low	Moderate
Urban Fire	Moderate	Moderate	Low	Moderate	Low	Moderate
Dam Failure	Low	Moderate $793K	Moderate	Low	Moderate	Low
Aviation Accident	Moderate	Low	Moderate	Low	Low	Low
Terrorism, Civil Unrest, and Violence	Low	Low	Moderate	Moderate	Low	Low
Railroad Accident	Moderate	Low	Low	Low	Low	Low
Volcano	Low	Moderate	Moderate	Moderate	Low	Low
Avalanche and Landslide	Moderate	Low	Low	Low	Moderate	Low

5. Mitigation Strategy

Hazard mitigation, as defined by the Disaster Mitigation Act of 2000, is any sustained action taken to reduce or eliminate the long-term risk to human life and property from hazards. The development of a mitigation strategy allows the community to create a vision for preventing future disasters, establish a common set of mitigation goals, prioritize actions, and evaluate the success of such actions.

The Park County Mitigation Strategy is based on the results of the risk assessment and recommendations by knowledgeable community members through the Local Emergency Planning Committee and public meetings. The overarching mission of this mitigation strategy is to:

Reduce or prevent losses from disasters.

Rather than wait until a disaster occurs, Park County, the City of Livingston, and the Town of Clyde Park have developed this strategy to move in a proactive direction in disaster prevention. All losses cannot be entirely mitigated, however, some actions can be taken, as funding and opportunities arise, that may reduce the impacts of disasters and eventually save taxpayers' money. The mitigation actions were developed based on direct input from the community and prioritized through a multi-step process.

Goals, Objectives, and Proposed Actions

Goal 1: *Reduce damages from flooding.*

Objective 1.1: Prevent damages from bridges and to critical facilities during flood events.

- Lessen hydraulic impacts when the following bridges are replaced: Emigrant Bridge, Carter's Bridge, Interstate 90 Bridge, Railroad Bridge at Highway 10/89 South, Highway 10/89 South Bridge, Highway 89 North Bridge (near the Shields River), Railroad Bridge at Highway 89 North (near the Shields River), and Springdale Bridge. [35]
- Remove abandoned bridge abutments and piers. [35]
- Consider zero backwater standards during bridge reconstruction, particularly at the Highway 10/89 South Bridge and the railroad bridge just downstream. [35]
- Require future school facilities be constructed outside the floodplain. [35]

Objective 1.2: Maximize the protection of life and property through government resources and services.

- Propose to the public a Park County Bond Issue for conservation easements and promote the use of state, federal, and private funds to protect values along the Yellowstone River. [35]
- Remove woody debris, as needed to protect public safety, but not excessively as such debris is important to ecological health. [35]
- Consider more restrictive regulations or prohibition of development in the floodplain.
- Map floodplain areas and join the National Flood Insurance Program in the Town of Clyde Park.
- Join and obtain points for the Community Rating System of the National Flood Insurance Program in Park County and the City of Livingston.

Objective 1.3: Provide the public with information and means to prevent private flood losses.
- Establish a Bank Stabilization Information Clearinghouse.[35]
- Establish financial incentives for landowners to remove, modify, or replace obsolete and non-functioning flood control and bank stabilization structures. [35]
- Conduct an analysis on the feasibility of a floodplain and floodway buyout and/or relocation program. [35]
- Educate the public on flood insurance.

Objective 1.4: Improve understanding of the flood hazard and mitigation measures.
- Conduct a US Army Corps of Engineers Section 205 Flood Control Study.[54]
- Conduct Bank Stabilization studies on project effectiveness and ecological health.[35]
- Study alternative flood mitigation measures. [35]
- Conduct a river migration study to measure the potential for river channel avulsion between the Livingston Ditch headgate and Interstate 90. [35]
- Investigate widening the channel near the City of Livingston levee by resloping the north bank in a terraced fashion in the area of the preliminary floodplain map cross sections #55,000 and #56,000. [35]

Goal 2: *Prevent losses from wildfires.*

Objective 2.1: Reduce private losses in the wildland/urban interface.
- Promote Firewise type programs.
- Require defensible space and inspection of new development in the wildland urban interface.
- Revise subdivision regulations with a better focus on defensible space/maintenance and water supply requirements in the wildland/urban interface.
- Reduce fuels along ingress and egress roadways.
- Conduct fuels reduction along utility right-of-ways.

Objective 2.2: Increase understanding of the wildfire hazard areas.
- Develop fuels mapping for public and private lands.
- Develop and maintain a Community Wildfire Protection Plan.
- Develop a centralized, countywide wildfire history database.

Goal 3: *Reduce potential losses from earthquakes.*

Objective 3.1: Prevent earthquake losses to critical facilities, vulnerable populations, and infrastructure.
- Tie down/secure objects in critical facilities and vulnerable population locations that could fall during an earthquake.
- Retrofit critical government facilities for earthquakes.
- Inspect key bridges for seismic stability.
- Anchor or stabilize electric transformers and generators for seismic motion during maintenance and new installations.
- Install expansion joints in underground utilities during new or replacement construction.

[54] Joint City/County Projects for a Grant Writer Priorities, February 28, 2005.

Objective 3.2: Minimize private earthquake losses.
- Educate home and business owners on simple earthquake retrofits.
- Survey commercial structures for earthquake stability and recommend retrofits.
- Create a financial incentive program for major earthquake retrofits in the priority hazard areas.

Goal 4: *Reduce losses from a transportation or hazardous materials accident.*

Objective 4.1: Allow for emergency traffic and evacuation routes during a hazardous materials or ground transportation incident.
- Develop an emergency transportation plan that considers key roadways and intersections.
- Study and construction of an additional railroad crossing.[54]

Goal 5: *Prevent significant loss of life from communicable disease and bioterrorism.*

Objective 5.1: Reduce the rapid spread of communicable diseases.
- Conduct a public education campaign on how to prevent the spread of disease.
- Establish a group made of area medical stakeholders to discuss disaster management and prevention issues.
- Install a new ventilation system in the City/County Complex and other critical facilities.[54]

Goal 6: *Promote all-hazard mitigation measures.*

Objective 6.1: Ensure critical infrastructure is operational during disasters.
- Identify, prioritize, and harden infrastructure from damages during disasters.
- Install or designate back-up systems for critical infrastructure, including emergency communications systems.
- Develop a dispatch function mutual aid system with Gallatin County.
- Install an uninterruptible power supply for Park County Dispatch.
- Protect North Repeater from vandals through bulletproof casing.

Objective 6.2: Improve warning capabilities.
- Become a National Weather Service Storm Ready Community.
- Develop an Emergency Alert System plan.
- Put NOAA Weather Radios in critical facilities and schools.

Objective 6.3: Increase emergency management and disaster service capabilities to prevent additional losses in a disaster.
- Create a finite, hardened Emergency Operations Center and alternate location.
- Develop a sheltering plan specific to utility failures.
- Install generators at critical facilities and vulnerable population locations.

Objective 6.4: Improve digital data for assessing all hazards.
- Develop GIS data that can be used with FEMA's HAZUS loss estimated models.

Action Prioritization

Each of the proposed projects has value, however, time and financial constraints do not permit all of the proposed actions be implemented immediately. By prioritizing the actions, the most critical, cost effective projects can be achieved in the short term. The prioritization of the projects serves as a guide for choosing and funding projects, however, depending on the funding sources, some actions may be best achieved outside the priorities established here.

To ensure that community goals and other factors are taken into account when prioritizing projects, a prioritization model that uses the following factors has been developed: cost (including management costs), feasibility (politically, socially, and environmentally), population benefit, property benefit, and hazard rating.

Each of the factors was ranked low, moderate, or high for each of the projects. The methods used to assign a category and the associated score can be generally defined as follows:

Cost:	3 Score	*Low*: < $10,000
(including management)	2 Score	*Moderate*: $10,000-$50,000
	1 Score	*High*: >$50,000
Feasibility:	1 Score	*Low*
(politically, socially,	2 Score	*Moderate*
environmentally)	3 Score	*High*
Population Benefit:	1 Score	*Low*: < 5% of population to benefit
(existing or future)	2 Score	*Moderate*: 5%-50% of population to benefit
	3 Score	*High*: > 50% of population to benefit
Property Benefit:	1 Score	*Low*: < 5% of property to benefit
(existing or future)	2 Score	*Moderate*: 5%-50% of property to benefit
	3 Score	*High*: > 50% of property to benefit
Hazard Rating:	1 Score	*Low*
(from risk assessment summary)	2 Score	*Moderate*
	3 Score	*High*

A summary of the scores for each of the proposed projects can be found in Table 5.1.

Table 5.1 Proposed Actions and Priority Scores for Park County

Goal 1: Reduce damages from flooding.						
Project	*Cost*	*Feasibility*	*Population Benefit*	*Property Benefit*	*Hazard Rating*	*Score*
Bridge replacement mitigation	Moderate	High	Low	Moderate	High	11
Remove bridge abutments and piers	Moderate	High	Low	Moderate	High	11
Zero backwater standards for bridges	Moderate	High	Low	Moderate	High	11
School facilities placement limitations	Low	Moderate	Moderate	Moderate	High	12
Conservation easement bond issue	Low	Moderate	Moderate	Moderate	High	12
Woody debris removal from rivers	Moderate	Moderate	Moderate	Moderate	High	11
More restrictive floodplain regulations	Low	Low	Moderate	High	High	12
Clyde Park NFIP mapping and participation	Low	Moderate	Low	Moderate	High	11
Park County/Livingston CRS participation	Low	Moderate	Moderate	Moderate	High	12
Bank stabilization information clearinghouse	Moderate	High	Low	Moderate	High	11
Flood control/stabilization improvement incentives	Moderate	Moderate	Low	Moderate	High	10
Buyout/relocation feasibility analysis	High	Moderate	Moderate	High	High	11
Flood insurance education	Low	High	Low	Moderate	High	12
USACE 205 Study	High	High	Moderate	High	High	12
Bank stabilization effectiveness studies	Moderate	High	Low	Moderate	High	11
Alternative flood mitigation measures study	Moderate	High	Low	Moderate	High	11
River migration study	High	High	Moderate	High	High	12
Channel widening investigation	High	High	Moderate	Moderate	High	11

Table 5.1 (continued) Proposed Actions and Priority Scores for Park County

Goal 2: Prevent losses from wildfires.						
Project	*Cost*	*Feasibility*	*Population Benefit*	*Property Benefit*	*Hazard Ratings*	*Score*
Firewise programs	Moderate	High	Moderate	Moderate	High	12
Defensible space requirements	Low	Moderate	Moderate	Moderate	High	12
Subdivision regulations for wildfire	Low	Moderate	Moderate	Moderate	High	12
Fuels reduction on roadways	Moderate	Moderate	Moderate	High	High	12
Fuels reduction for utilities	Moderate	Moderate	High	Moderate	High	12
Fuels mapping	Moderate	High	Moderate	Moderate	High	12
Community Wildfire Protection Plan	Moderate	High	Moderate	Moderate	High	12
Wildfire history database	Moderate	High	Low	Low	High	10
Goal 3: Reduce potential losses from earthquakes.						
Project	*Cost*	*Feasibility*	*Population Benefit*	*Property Benefit*	*Hazard Ratings*	*Score*
Critical facilities tie downs	Low	High	High	Low	High	13
Critical facilities retrofits	Moderate	Moderate	High	Moderate	High	12
Seismic bridges inspections	Moderate	High	High	Low	High	12
Anchor transformers and generators	Low	High	Moderate	Low	High	12
Expansion joints for utilities	Moderate	High	High	Low	High	12
Earthquake retrofit education	Low	Moderate	Moderate	Moderate	High	12
Commercial structures seismic surveys	Moderate	Moderate	Moderate	Moderate	High	11
Earthquake retrofits financial incentives	Moderate	Moderate	Moderate	Moderate	High	11
Goal 4: Reduce losses from a transportation or hazardous materials accident.						
Project	*Cost*	*Feasibility*	*Population Benefit*	*Property Benefit*	*Hazard Ratings*	*Score*
Emergency transportation plan	Low	High	Moderate	Low	High	12
Railroad crossing study and construction	High	Moderate	Moderate	Low	High	11
Goal 5: Prevent significant loss of life from communicable disease and bioterrorism.						
Project	*Cost*	*Feasibility*	*Population Benefit*	*Property Benefit*	*Hazard Ratings*	*Score*
Disease prevention education	Low	Moderate	Moderate	Low	Moderate	10
Medical stakeholders group	Low	Moderate	Moderate	Low	Moderate	10
City/County Complex ventilation system	Moderate	High	Moderate	Low	Moderate	10

Table 5.1 (continued) Proposed Actions and Priority Scores for Park County

Goal 6: *Promote all-hazard mitigation measures.*						
Project	*Cost*	*Feasibility*	*Population Benefit*	*Property Benefit*	*Hazard Ratings*	*Score*
Prioritize and harden infrastructure	High	High	High	Low	High	11
Critical infrastructure back-up systems	High	High	High	Low	High	11
Dispatch mutual aid system	Low	Moderate	High	Low	High	11
UPS for dispatch	Moderate	High	High	Low	High	12
North Repeater bulletproof casing	Low	High	Moderate	Low	High	12
NWS Storm Ready Community	Low	High	Moderate	Low	High	12
Emergency Alert System plan	Moderate	High	High	Low	High	12
NOAA weather radios in critical facilities	Low	High	Moderate	Low	High	12
Established EOC and alternate	High	Moderate	High	Moderate	High	11
Utility failure sheltering plan	Low	Moderate	Moderate	Low	Moderate	10
Generators for critical facilities	Moderate	High	Moderate	Low	High	11
HAZUS GIS data development	Moderate	High	Low	Moderate	High	11

Implementation Plan

Those actions that have received the highest scores will be given the highest priority. As funding or opportunities to initiate these projects come up, the higher priority activities can be prioritized even further with more detailed costs, benefits, and other criteria. The implementation strategy for the proposed actions can be found in Table 5.2.

Table 5.2 Implementation Plan for Actions in Park County, Livingston, and Clyde Park

Project Description	Jurisdiction	Responsible Department/Partner	Potential Funding Source(s)	Priority Score
Tie down/secure objects in critical facilities and vulnerable population locations that could fall during an earthquake.	Park County Livingston Clyde Park	Facility managers/owners All departments	Internal FEMA Businesses	13
Require future school facilities be constructed outside the floodplain.	Park County Livingston	Planning Departments School Districts	Internal	12
Propose to the public a Park County Bond Issue for conservation easements and promote the use of state, federal, and private funds to protect values along the Yellowstone River.	Park County Livingston	Commissioners	Taxpayers/Bond FEMA DNRC Foundations	12
Consider more restrictive regulations or prohibition of development in the floodplain.	Park County Livingston	Planning Departments	Internal	12
Join and obtain points for the Community Rating System of the National Flood Insurance Program in Park County and the City of Livingston.	Park County Livingston	Floodplain Managers Commissioners DES	Internal FEMA DNRC	12
Educate the public on flood insurance.	Park County Livingston	Floodplain Managers DES Insurance Agents	Internal FEMA DNRC Businesses	12
Conduct a US Army Corps of Engineers Section 205 Flood Control Study.	Park County Livingston	Commissioners Floodplain Managers	Internal USACE	12
Conduct a river migration study to measure the potential for river channel avulsion between the Livingston Ditch headgate and Interstate 90.	Livingston	Floodplain Manager Commissioners	Internal FEMA DNRC	12
Promote Firewise type programs.	Park County	Fire Departments Homeowners Associations	Internal DNRC USFS BLM FEMA Homeowners	12
Require defensible space and inspection of new development in the wildland urban interface.	Park County	Fire Departments Planning Department Homeowners Associations	Internal Developers	12
Revise subdivision regulations with a better focus on defensible space/maintenance and water supply requirements in the wildland/urban interface.	Park County	Fire Departments Planning Department	Internal	12

Table 5.2 (continued) Implementation Plan for Actions in Park County, Livingston, and Clyde Park

Project Description	Jurisdiction	Responsible Department/Partner	Potential Funding Source(s)	Priority Score
Reduce fuels along ingress and egress roadways.	Park County	Fire Departments Homeowners Associations Land Management Agencies	Internal DNRC USFS BLM FEMA Homeowners	12
Conduct fuels reduction along utility right-of-ways.	Park County	Utility Providers Fire Departments Land Management Agencies	Internal DNRC USFS BLM FEMA Utility Owners	12
Develop fuels mapping for public and private lands.	Park County	Fire Departments Land Management Agencies	Internal DNRC USFS BLM FEMA	12
Develop and maintain a Community Wildfire Protection Plan.	Park County	Fire Departments	Internal DNRC USFS BLM FEMA	12
Retrofit critical government facilities for earthquakes.	Park County Livingston Clyde Park	Facility managers/owners All departments Building Department	Internal FEMA	12
Inspect key bridges for seismic stability.	Park County Livingston Clyde Park	Montana DOT Roads/Streets Departments	Internal MT DOT FEMA	12
Anchor or stabilize electric transformers and generators for seismic motion during maintenance and new installations.	Park County Livingston Clyde Park	Utility Providers Facility Managers/Owners	Internal FEMA Utility Owners	12
Install expansion joints in underground utilities during new or replacement construction.	Park County Livingston Clyde Park	Utility Departments Utility Providers	Internal FEMA Utility Owners Homeowners Developers	12
Educate home and business owners on simple earthquake retrofits.	Park County Livingston Clyde Park	DES Red Cross	Internal FEMA	12
Develop an emergency transportation plan that considers key roadways and intersections.	Park County Livingston Clyde Park	DES Law Enforcement Fire Departments	Internal	12
Install an uninterruptible power supply for Park County Dispatch.	Park County	DES Dispatch	Homeland Security	12
Protect North Repeater from vandals through bulletproof casing.	Park County	DES Dispatch	Homeland Security	12
Become a National Weather Service Storm Ready Community.	Park County Livingston Clyde Park	DES	Internal NWS	12
Develop an Emergency Alert System plan.	Park County Livingston Clyde Park	DES	Internal Homeland Security	12

Table 5.2 (continued) Implementation Plan for Actions in Park County, Livingston, and Clyde Park

Project Description	Jurisdiction	Responsible Department/Partner	Potential Funding Source(s)	Priority Score
Put NOAA Weather Radios in critical facilities and schools.	Park County Livingston Clyde Park	DES Facility Managers/Owners School Districts	Internal FEMA	12
Lessen hydraulic impacts when the following bridges are replaced: Emigrant Bridge, Carter's Bridge, Interstate 90 Bridge, Railroad Bridge at Highway 10/89 South, Highway 10/89 South Bridge, Highway 89 North Bridge (near the Shields River), Railroad Bridge at Highway 89 North (near the Shields River), and Springdale Bridge.	Park County Livingston	Roads/Street Departments Montana DOT MRL	Internal MT DOT FEMA DNRC MRL	11
Remove abandoned bridge abutments and piers.	Park County Livingston	Roads/Street Departments Montana DOT MRL	Internal MT DOT FEMA DNRC MRL	11
Consider zero backwater standards during bridge reconstruction, particularly at the Highway 10/89 South Bridge and the railroad bridge just downstream.	Park County Livingston	Roads/Street Departments Montana DOT MRL	Internal MT DOT MRL	11
Remove woody debris, as needed to protect public safety, but not excessively as such debris is important to ecological health.	Park County Livingston	Roads/Street Departments Montana DOT	Internal MT DOT	11
Map floodplain areas and join the National Flood Insurance Program in the Town of Clyde Park.	Clyde Park	Town Council	Internal FEMA DRNC	11
Establish a Bank Stabilization Information Clearinghouse.	Park County Livingston	Planning Departments	Internal FEMA DNRC Foundations	11
Conduct an analysis on the feasibility of a floodplain and floodway buyout and/or relocation program.	Livingston	Floodplain Manager DES	Internal FEMA DNRC	11
Conduct Bank Stabilization studies on project effectiveness and ecological health.	Park County Livingston	Floodplain Manager	Internal FEMA DNRC Foundations	11
Study alternative flood mitigation measures.	Park County Livingston	DES Floodplain Manager	Internal FEMA DNRC Foundations	11
Investigate widening the channel near the City of Livingston levee by resloping the north bank in a terraced fashion in the area of the preliminary floodplain map cross sections #55,000 and #56,000.	Livingston	Floodplain Manager	Internal USACE	11
Survey commercial structures for earthquake stability and recommend retrofits.	Park County Livingston Clyde Park	DES Building Department	Internal FEMA Businesses	11
Create a financial incentive program for major earthquake retrofits in the priority hazard areas.	Park County Livingston Clyde Park	DES	Internal FEMA Businesses	11

Table 5.2 (continued) Implementation Plan for Actions in Park County, Livingston, and Clyde Park

Project Description	Jurisdiction	Responsible Department/Partner	Potential Funding Source(s)	Priority Score
Study and construction of an additional railroad crossing.	Park County Livingston	Commissioners Road Departments MRL	Internal MRL MT DOT	11
Identify, prioritize, and harden infrastructure from damages during disasters.	Park County Livingston Clyde Park	DES Utility Providers	Internal Homeland Security FEMA	11
Install or designate back-up systems for critical infrastructure, including emergency communications systems.	Park County Livingston Clyde Park	DES Utility Providers	Internal Homeland Security FEMA	11
Develop a dispatch function mutual aid system with Gallatin County.	Park County	Dispatch	Internal	11
Create a finite, hardened Emergency Operations Center and alternate location.	Park County Livingston Clyde Park	DES Commissioners	Internal	11
Install generators at critical facilities and vulnerable population locations.	Park County Livingston Clyde Park	Facility managers/owners All departments	Internal FEMA Businesses	11
Develop GIS data that can be used with FEMA's HAZUS loss estimated models.	Park County	GIS Department DES	Internal FEMA	11
Establish financial incentives for landowners to remove, modify, or replace obsolete and non-functioning flood control and bank stabilization structures.	Park County Livingston	Floodplain Manager DES	Internal FEMA DNRC Foundations	10
Develop a centralized, countywide wildfire history database.	Park County Livingston Clyde Park	Fire Departments	Internal DNRC USFS BLM FEMA	10
Conduct a public education campaign on how to prevent the spread of disease.	Park County Livingston Clyde Park	Public Health Department	Internal DPHHS	10
Establish a group made of area medical stakeholders to discuss disaster management and prevention issues.	Park County Livingston Clyde Park	Public Health Department Medical Providers	Internal Businesses	10
Install a new ventilation system in the City/County Complex and other critical facilities.	Park County Livingston	Facility Manager	Internal	10
Develop a sheltering plan specific to utility failures.	Park County Livingston Clyde Park	Red Cross DES	Internal	10

Enabling Legislation

The enabling legislation for the implementation of this plan specifically comes from Section 322, Mitigation Planning, of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, enacted by Section 104 of the Disaster Mitigation Act of 2000 (P.L. 106-390). The Interim Final Rule for this legislation was published in the Federal Register on February 26, 2002 at 44 CFR Part 201. Other legislation, orders, and plans that support the initiatives presented in this plan include:

- Presidential Executive Order 12898, Environmental Justice
- Presidential Executive Order 11988, Floodplain Management
- Presidential Executive Order 11990, Protection of Wetlands
- Montana Code Annotated, Title 10, Chapter 3, Disaster and Emergency Services
- Montana Code Annotated, Title 76, Chapter 5, Flood Plain and Floodway Management
- Montana Code Annotated, Title 50, Chapter 60, Building Construction Standards
- Montana Code Annotated, Title 76, Chapter 2, Planning and Zoning
- Park County Growth Policy
- Park County Subdivision Regulations
- Park County and City of Livingston Floodplain Ordinances
- City of Livingston Building Code
- City-County Zoning Regulations

Existing Programs

The approval of this plan shows that hazard mitigation is an important priority in Park County, Livingston, and Clyde Park. As a priority, the hazard information and recommendations presented in this plan will be considered and incorporated into current and future planning initiatives, particularly growth policies, capital improvement plans, zoning regulations, and subdivision regulations.

The Local Emergency Planning Committee is already active in the promotion of hazard mitigation and will continue to do so with the member agencies represented. A city-county grants committee, with individual grant committees for each jurisdiction, has funded a grant writer and will focus on implementing this plan by selecting projects, applying for funds, and managing the grants.

Additional support for mitigation will be encouraged by the Park County and Livingston Planning Departments through building codes, subdivision review, and land use permits. The many organizations devoted to sustainable communities and the protection of natural resources will be encouraged to use this plan and support its goals.

6. Plan Maintenance Procedures

Plan Monitoring, Evaluation, and Updates

This plan is maintained by the Park County LEPC. This committee has representatives from local public safety departments and private entities. All were active in the development of this plan. Annually at the September LEPC meeting, a public meeting will be held to review the plan. Notices will be posted in The Livingston Enterprise newspaper. Annual updates should be made and committee approval may then take place at the October meeting or subsequent meetings. As hazard information is added or updated, events occur, and projects are completed, the plan will be updated. Each year, a notice of approval will be sent to Montana Disaster & Emergency Services by the Park County LEPC Chairperson, and if major changes take place, a revised version of the plan will also be submitted. Every five years, the plan will be submitted to Montana Disaster & Emergency Services and the Federal Emergency Management Agency Regional Office for their approval. The next formal submission will occur in August 2010. Table 6.1 outlines the update schedule for the plan.

Table 6.1 Park County Schedule of Updates

Plan Section	Post-Disaster	Annually	Every 5 Years
Annual Report to Montana DES		X	X
Adoption Documentation	X	X	X
Introduction			X
Planning Process	X	X	X
Hazard Identification	X		X
Critical Facilities			X
Buildings			X
Infrastructure			X
Economy			X
Land Use and Future Development			X
Vulnerability Assessment Methodology			X
Hazard Profiles	X	X	X
Risk Assessment Summary			X
Goals, Objectives, and Proposed Actions	X	X	X
Action Prioritization	X	X	X
Implementation Plan	X	X	X
Plan Maintenance Procedures			X

Public Involvement

An important aspect of this plan since its inception has been public involvement. To encourage continued participation, comments can be directed to the Park County LEPC Chairperson. This committee can be reached through Disaster & Emergency Services at:

Park County Disaster & Emergency Services
City/County Complex
414 East Callender Street
Livingston, MT 59047
406-222-4190

Comments will be considered during the annual review of this plan. The public is also encouraged to attend the annual plan review meeting. If needed, a special LEPC subcommittee will be developed to hold public meetings and coordinate plan changes and comments.

Appendix A

Public Meeting Documentation

Appendix B

Meeting Attendance Records

Appendix C

References/Footnotes

References/Footnotes

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Appendix D

Acronyms

Acronyms

ALF – Animal Liberation Front
BLM – Bureau of Land Management
BNSF – Burlington Northern Santa Fe
CAMA – Computer Assisted Mass Appraisal
CFR – Code of Federal Regulations
CRS – Community Rating System
DES – Disaster and Emergency Services
DNRC – Department of Natural Resources and Conservation
DOT – Department of Transportation
DPHHS – Department of Public Health and Human Services
ELF – Earth Liberation Front
EMS – Emergency Medical Services
EOC – Emergency Operations Center
EOP – Emergency Operations Plan
EPA – Environmental Protection Agency
FAA – Federal Aviation Administration
FBI – Federal Bureau of Investigation
FEMA – Federal Emergency Management Agency
FIRM – Flood Insurance Rate Map
FIS – Flood Insurance Study
GIS – Geographic Information System
GPS – Global Positioning System
HAZUS-MH – Hazards US Multi-Hazard
LEPC – Local Emergency Planning Committee
MBMG – Montana Bureau of Mines and Geology
MRL – Montana Rail Link
MT DOT – Montana Department of Transportation
NFIP – National Flood Insurance Program
NID – National Inventory of Dams
NOAA – National Oceanic and Atmospheric Administration
NTSB – National Transportation & Safety Board
NWS – National Weather Service
PGA – Peak Ground Acceleration
RYO – Reintegrating Youthful Offenders
SARA – Superfund Amendments and Reauthorization Act
SFHA – Special Flood Hazard Area
USACE – United States Army Corps of Engineers
USDA – United States Department of Agriculture
USGS – United States Geological Survey
USFS – United States Forest Service
WUI – Wildland/Urban Interface
YVO – Yellowstone Volcano Observatory

Appendix E

Crosswalk Reference Document

Appendix F

FEMA/State Approval Letter